English for Science and Technology

Architecture and building construction

Английский язык

АСТРЕЛЬ

James Cumming

для студентов архитектурных и строительных специальностей

Джеймс Камминг

Longman

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ARCHITECTURE AND BUILDING CONSTRUCTION

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АНГЛИЙСКИЙ ЯЗЫК

ДЛЯ СТУДЕНТОВ АРХИТЕКТУРНЫХ И СТРОИТЕЛЬНЫХ СПЕЦИАЛЬНОСТЕЙ

Учебник

Предисловие к русскому изданию

и англо-русский словарь

проф. **В.Н. Бгашева**

АСТ • Астрель
2005

Справочный материал учебного комплекса

Среди умений работы с оригинальной литературой по специальности, в том числе и на иностранном языке, большую роль играют так называемые «справочные» умения, которые являются основой самостоятельной работы с текстом. Среди них особо надо выделить умение отбирать необходимую литературу по теме, группировать отобранный материал по разделам, находить дополнительный материал в справочниках, а также работать с англо-русским политехническим или специализированным словарем (навыки и умения быстрого нахождения значений незнакомых слов). Специальные «справочные» разделы в учебнике по иностранному языку, а также словари-минимумы являются эффективным вспомогательным учебным материалом для развития справочных умений. Такими разделами в учебнике Джеймса Камминга являются:

1) книга для преподавателя,
2) словарь, снабженный переводом всех единиц на русский язык в данном издании,
3) правила чтения некоторых математических и иных символов,
4) сокращения и условные обозначения.

Эти разделы являются необходимым справочным материалом при работе с текстами основного пособия и при подготовке студентами кратких сообщений на иностранном языке.

Заключение

Высокий уровень профессиональной компетенции специалиста достигается наличием у него определенного набора профессиональных умений и навыков. Иноязычные умения и навыки успешно реализуются в составе коммуникативной компетенции лишь тогда, когда они соответствуют профессиональным умениям и навыкам, зафиксированным в нашей стране Государственным образовательным стандартом высшего профессионального образования.

Учебник Джеймса Камминга «Английский язык для студентов архитектурных и строительных специальностей» успешно работает на формирование у студентов навыков и умений иноязычного общения в конкретных профессиональных, деловых, научных сферах и ситуациях.

Русское издание учебника Джеймса Камминга может быть рекомендовано студентам архитектурных и строительно-инженерных высших учебных заведений. Учебник может также быть полезным студентам архитектурно-строительных техникумов и колледжей, а также профессиональным архитекторам и строителям, решившим усовершенствовать свои профессиональные знания в области английского языка.

проф. В. Н. Бгашев

Introduction

1 Aims of the Students' Book

The aim of the architecture and building construction course is to develop in the student a competence in using English receptively and actively to enable him to extract information from written and oral texts and from visual forms of presentation, and to develop the student's ability to follow continuous arguments. After completing the course, the student should have the confidence and ability to go to a book or a journal, to a lecture or other oral presentation, on a topic related to architecture and building construction, and be equipped to find, understand and extract the information he needs.

In order to do this the student will need to be able to read and listen for information, and he will also need to talk about what he reads and hears, so the course includes a considerable amount of oral work. There are also a number of written exercises. The emphasis to be given to the different skills will vary according to the needs of the learners, but this book can serve both teacher and learner as a basis for a course in all four skills.

2 Content of the Students' Book

The course does not aim to teach architecture and building construction. Its purpose is to teach English for architecture and building construction. But the twelve units cover most of the basic concepts associated with the word 'building'. Normally, the word 'building' is used to refer to one of four separate and distinct concepts:

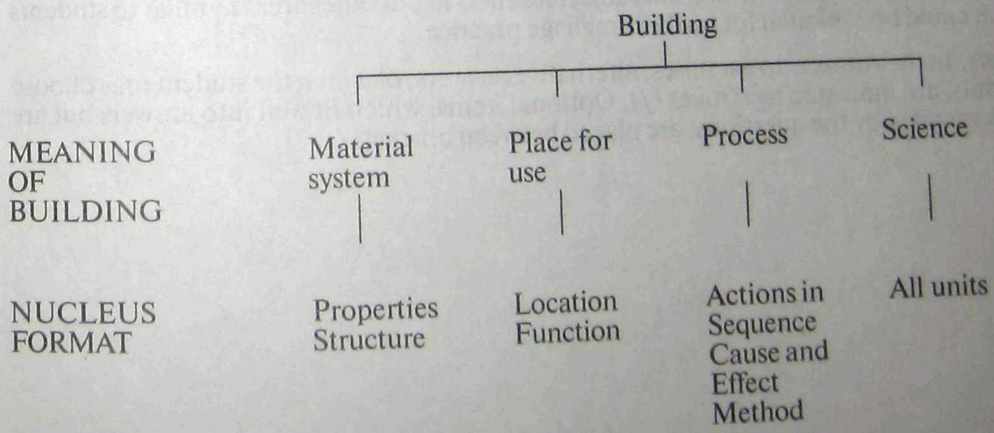
(*i*) *a material system* – the building materials and building components which go together to make building systems.

(*ii*) *a living place* – a building is a place where things have been placed in certain defined positions to meet a set of requirements. Its function is to modify the environment and to provide a shelter for people.

(*iii*) *the process of building* – the process of building is a sequence of operations and the resulting building is the outcome of a succession of moves to put predetermined building materials and components in predetermined positions.

(*iv*) *the science of building* – the organised body of knowledge concerning what is built, why it is built, how it is done and how it is measured.

The relation of 'building' to the Nucleus format:



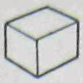
STUDENTS' BOOK

Unit 1 Properties and Shapes

Section 1 Presentation

1. Look at these:

Here are some examples of basic forms:

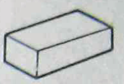


a cube

a hemisphere

a triangular prism

a pyramid

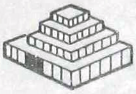


a rectangular prism

a cone

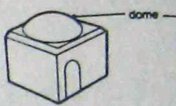
a cylinder

Now look at these drawings of buildings and building components:



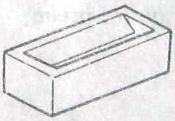
a hotel

a minaret

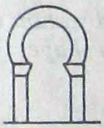


an Egyptian house

a mosque

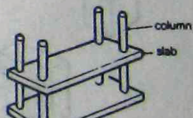


a brick

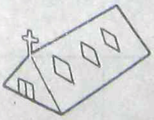


an Arabic arch

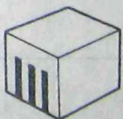
a Roman arch



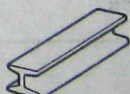
the structure of a factory



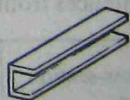
a church



a power station building



a steel beam



a steel channel

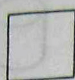
Look at this example:

The brick is shaped like a rectangular prism.

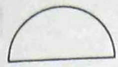
Now complete these sentences:

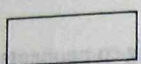
a) The hotel is shaped like a ______ .
b) The top of the minaret . . . . . .
c) The dome of the Egyptian house . . . . . .
d) The column . . . . . .
e) The slab . . . . . .
f) The church . . . . . .
g) The power station building . . . . . .

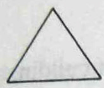
2. Look at these drawings of two-dimensional shapes:


a square shape

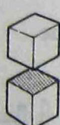

a circular shape


a semi-circular shape

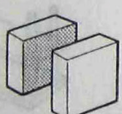

a rectangular shape


a triangular shape

Now look and read:



The *cross-section* of a square prism is square *in shape*.



The *longitudinal section* of a square prism is rectangular *in shape*.

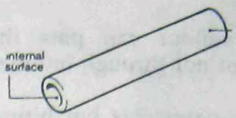
Make sentences from this table:

The cross-section of the The longitudinal section of the	brick hotel top of the minaret column church	is	square circular semi-circular rectangular triangular	in shape.

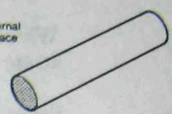
3. **Now answer these questions about the drawings in exercise 1:**

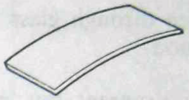
a) Which building is pencil-shaped?
b) Which building component is I-shaped in cross-section?
c) Which building component is C-shaped in cross-section?
d) Which dome is egg-shaped?
e) Which arch is horseshoe-shaped?
f) Which building has diamond-shaped windows?

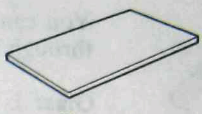
4. **Look and read:**



a tube is *hollow*


a rod is *solid*


a *curved* surface


a *flat* surface

The power station building is hollow. It has five flat external surfaces.

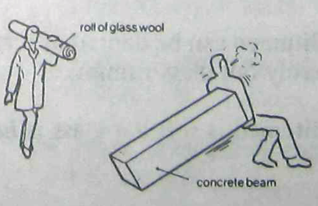
Now describe these buildings and components in a similar way:

a) The church
b) The slab
c) The column
d) The mosque
e) The steel beam

5. **Now describe the shapes of the buildings in exercise 1, page 17 and compare them with the buildings around you.**

Section 2 Development

6. **Look at these examples:**

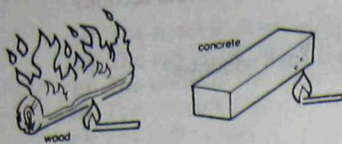


A man can easily lift a large roll of glass wool but not a concrete beam.

Glass wool is *light* but concrete is *heavy*.

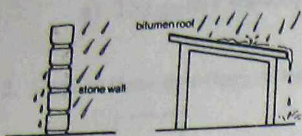
A man can bend a rubber tile but not a concrete tile.

Rubber is *flexible* but concrete is *rigid*.



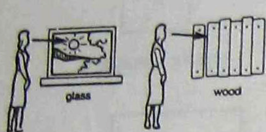
Wood can burn but concrete cannot burn.

Wood is *combustible* but concrete is *non-combustible*.



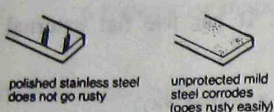
Water vapour can pass through stone but not through bitumen.

Stone is *permeable* but bitumen is *impermeable*.



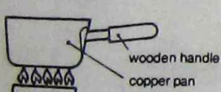
You can see through glass but not through wood.

Glass is *transparent* but wood is *opaque*.



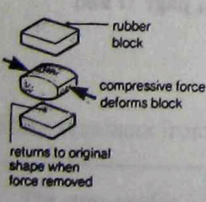
Stainless steel can resist corrosion but mild steel cannot.

Stainless steel is *corrosion resistant* but mild steel is *not corrosion resistant*.

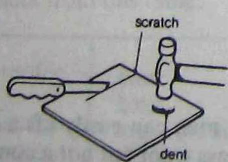


Heat can be easily transferred through copper but not through wood.

Copper is a *good conductor of heat* but wood is a *poor conductor of heat*.



Rubber can be stretched or compressed and will then return to its original shape but clay cannot.

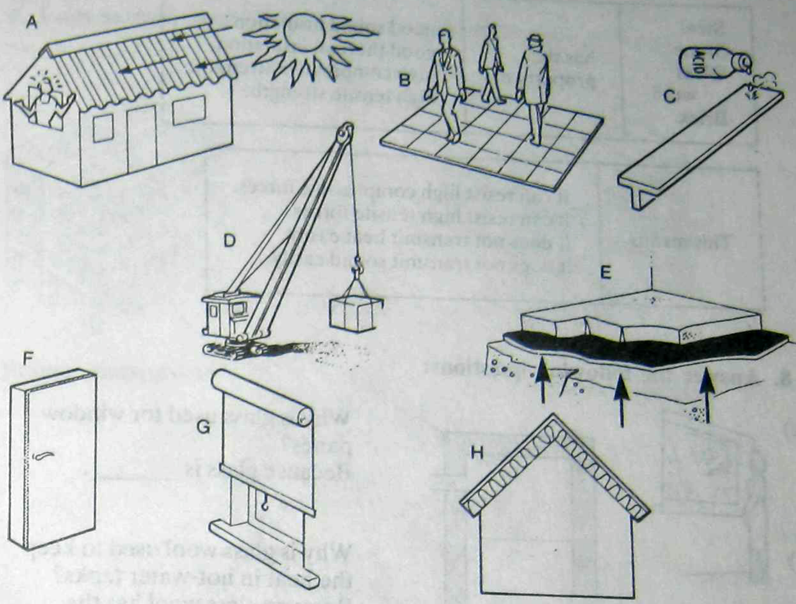


Rubber is *elastic* but clay is *plastic*.

Bitumen can be dented or scratched easily but glass cannot.

Bitumen is *soft* but glass is *hard*.

Look at these diagrams. Match the letters A–H in the diagrams with the sentences below:



Now complete these sentences with properties:

a) The polythene membrane can prevent moisture from rising into the concrete floor. This means that polythene is _______.

b) The T-shaped aluminium section can resist chemical action, i.e. aluminium is . . . . . .

c) The stone block cannot be lifted without using a crane. This means that stone is _______.

d) The corrugated iron roof cannot prevent the sun from heating up the house, i.e. iron is . . . . . .

e) Glass wool can help to keep a house warm in the winter and cool in the summer, i.e. glass wool is . . . . . .

f) The ceramic tiles on the floor cannot be scratched easily by people walking on them. This means that ceramic tiles are _______.

g) Asbestos sheeting can be used to fireproof doors. In other words asbestos is _______.

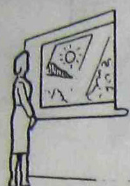
h) Black cloth blinds can be used to keep the light out of a room, i.e. cloth is _______.

7. Make sentences about four other properties of materials from this table:

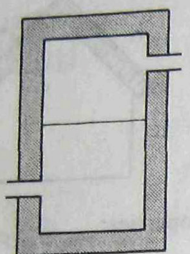
Steel Stone Glass wool Brick	has the property of	good sound insulation. good thermal insulation. high compressive strength. high tensile strength.

This means	it can resist high compressive forces. it can resist high tensile forces. it does not transmit heat easily. it does not transmit sound easily.

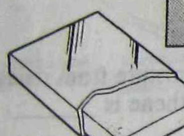
8. Answer the following questions:

a) 

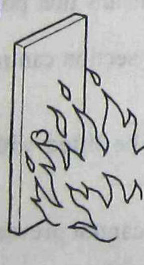
Why is glass used for window panes?
Because glass is ________.

b) 

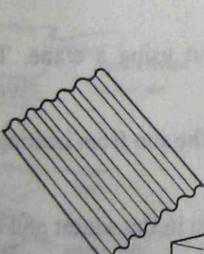
Why is glass wool used to keep the heat in hot-water tanks?
Because glass wool has the property of . . . . . .

c) 

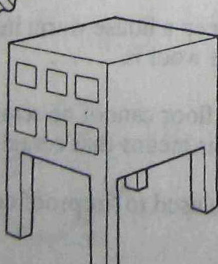
Why is some steel covered with a thin layer of zinc?
Because zinc is . . . . . .

d) 

Why are some fire doors covered with asbestos sheets?
Because asbestos is . . . . . .

e) 

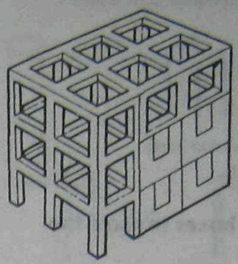
Why are some metal sheets formed into a corrugated shape?
Because the corrugated shape makes the sheet ________.

f) 

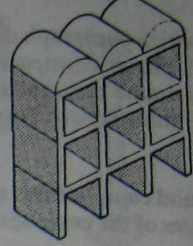
Why is concrete used for the columns of a building structure?
Because . . . . . .

Section 3 Reading

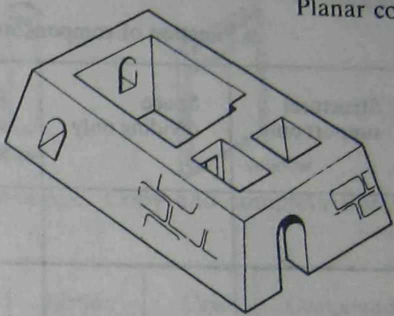
9. Look at these diagrams and then read the passage:



Frame construction



Planar construction



Mass construction

Building materials are used in two basic ways. In the first way they are used to support the loads on a building and in the second way they are used to divide the space in a building. Building components are made from building materials and the form of a component is related to the way in which it is used. We can see how this works by considering three different types of construction:

1. In one kind of construction, blocks of materials such as brick, stone, or concrete are put together to form solid walls. These materials are heavy, however, they can support the structural loads because they have the property of high compressive strength. Walls made up of blocks both support the building and divide the space in the building.

2. In another type of construction, sheet materials are used to form walls which act as both space-dividers and structural support. Timber, concrete and some plastics can be made into large rigid sheets and fixed together to form a building. These buildings are lighter and faster to construct than buildings made up of blocks.

3. Rod materials, on the other hand, can be used for structural support but not for dividing spaces. Timber, steel and concrete can be formed into rods and used as columns. Rod materials with high tensile and compressive strength can be fixed together to form framed structures. The spaces between the rods can be filled with light sheet materials which act as space dividers but do not support structural loads.

Now say which paragraph discusses:

a) planar construction
b) frame construction
c) mass construction

10. Copy and complete this table by putting ticks in the boxes to show the functions of the components:

	Function of components		
Form of material	Structural support only	Space dividing only	Both structural support and space dividing
Blocks			✓
Sheets			
Rods			

11. Now say whether these statements are true or false. Correct the false statements.

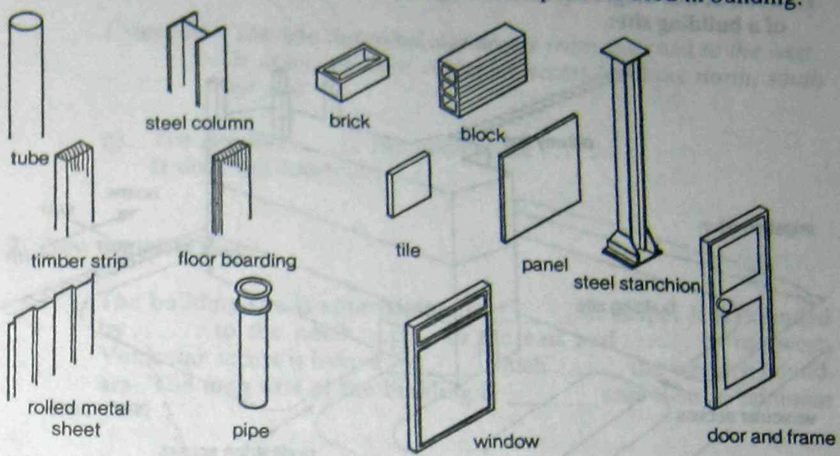
a) Rod materials can be used for both dividing space and supporting the building.
b) Concrete can be used as a block material, a sheet material and a rod material.
c) Steel is used for frame construction because it has high tensile strength and low compressive strength.
d) The sheet materials, which act as space dividers in a frame construction building, can be very light because they do not support structural loads.
e) Mass construction buildings are light whereas planar construction buildings are heavy.

12. Look at the buildings in exercise 1, page 17 and discuss the basic forms of the materials used to build them.

Section 4 Listening

13. Look and read:

These are drawings of the three types of components used in building:



Now listen to the passage. Copy and complete this table to classify the components:

	Section	Unit	Compound unit
Name of component	Tube		

14. Now complete these sentences:

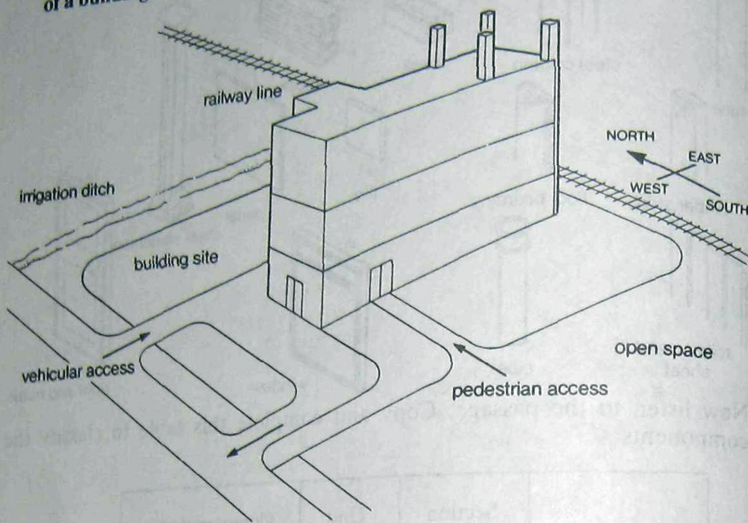
a) A copper tube is an example of a ________ because it is . . . . . .
b) A concrete block is an example of a ________ because . . . . . .
c) A steel stanchion is an example of a ________ ________ because . . . .

15. Listen to the passage again and draw a sketch of the compound unit described.

Unit 2 Location

Section 1 Presentation

1. Look at this diagram of a building under construction in the southern part of a building site:



Now look at the examples and complete the following sentences:

Example: The *front* of the building *faces west*.
It is a *west-facing* wall.

a) The back of the building ......
It is ......

b) The sides of the building ......
They are ......

Example: The *long axis* of the building *is orientated east-west*.
The *orientation of the long axis* is *east-west*.

c) The short axis of the building ......
The orientation ......

Example: The longer walls of the building face north and south to minimise the area of wall exposed to the sun.

d) The shorter walls of the building ......

Example: The site *is bounded by* a road *to the west*.
A road *runs along the western boundary*.

e) The site ...... an irrigation ditch ......
An irrigation ditch ......

f) The site is bounded by ...... to the east.
...... runs along the eastern boundary.

Example: The site has vehicular *access from* the road *to the west*.
It does not have vehicular *access from the north, south or east*.

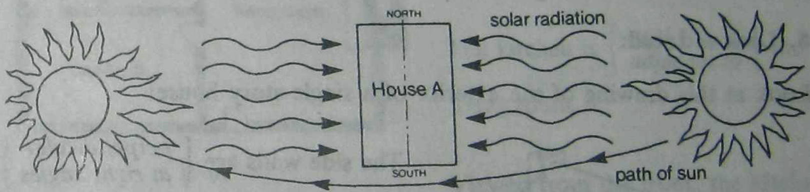
g) The site has ...... the open space ......
It does not have ......

2. Now complete this:

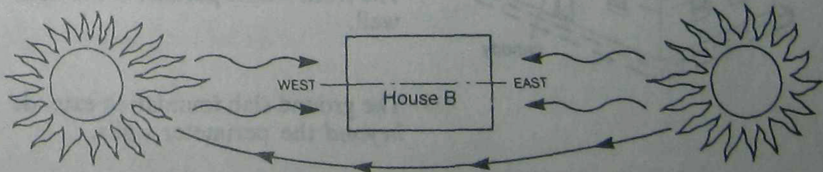
The building site is approximately _______ in shape. It is bounded by ...... to the north, ... to the east and ...... to the west. Vehicular access is from a _______ which ...... the western boundary. The long axis of the building is _______ east-west to minimise ......

3. Now write a similar description of a building site in your local area.

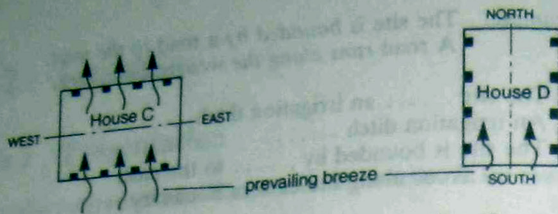
4. Look at these diagrams and answer the following questions:



a) In which direction do the longer walls of House A face?
b) Does this maximise the area of wall exposed to the sun?
c) Does this help to keep the inside of the house cool?



d) In which direction is the long axis of House B orientated?
e) Will the inside of House B be cooler than the inside of House A? Why?



f) Which house has the minimum length of wall exposed to the prevailing breeze?
g) Which house has the best orientation for a hot country?
h) In a warm-humid country with the prevailing wind from the east, what is the best orientation for the long axis of a house? Draw a diagram.

5. Read this:

Four factors which can influence the orientation of buildings are:
1. climate
2. view
3. building site requirements, e.g. the shape of a building site may determine the orientation of a building
4. the function of the building, e.g. a coastguard building will look out to sea

Now look at some local buildings and say which factors have helped to determine their orientation.

Section 2 Development

6. Look and read:

Look at this drawing of the exterior of a single-story house:

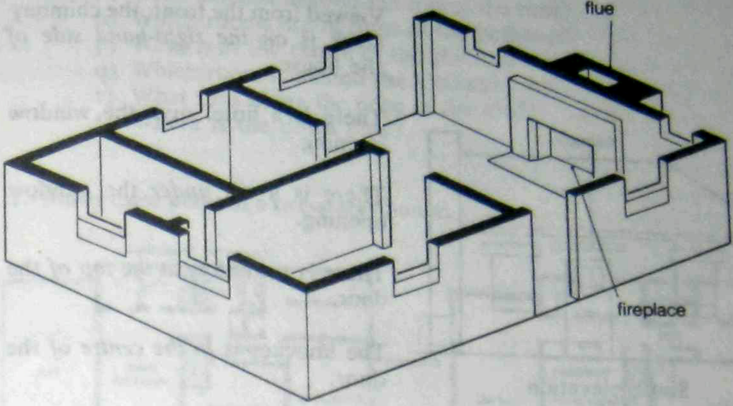
The side walls are { *perpendicular* / *at right angles* } *to* the front wall.

The front wall is *parallel to* the back wall.

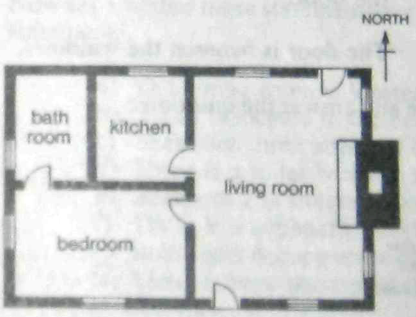
The ground slab foundation extends *beyond* the perimeter walls.

The roof of the house is removed by cutting along line AB which is parallel to the floor.

Now look at a cut-away view of the interior of the house:



A view looking straight down on a cut-away view of the interior of a building is known as a *plan*:



Plan

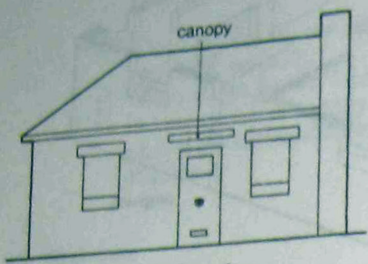
Looking north, the living room is *on the right of* the house.

Looking north, the bedroom is *to the left of* the living room.

The kitchen is { *next to* / *adjacent to* } the living room.

Viewed from the front, the kitchen is *behind* the bedroom (or, the bedroom is *in front of* the kitchen).

Views at right angles to the front, rear and sides of a building are known as *elevations*:



South elevation

Viewed from the front, the chimney stack is *on the right-hand side of* the house.

There is a lintel *over* the window opening.

There is a sill *under* the window opening.

There is a window *at the top of* the door.

The knocker is *in the centre of* the door.

The letter box is *at the bottom of* the door.

There are windows *on either side of* the door.

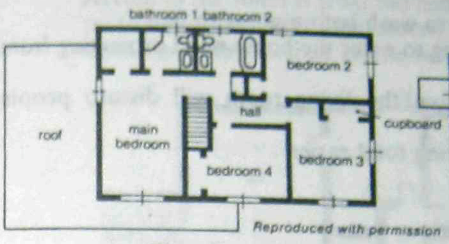
The door is *between* the windows.

Now look at this elevation of the house and answer the questions:

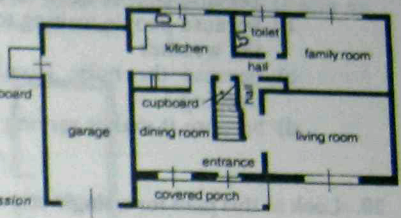
a) Is this the north or west elevation of the house?
b) Which wall is parallel to it?
c) Which walls are at right angles to it?
d) Does the back door have a canopy over it?
e) Is the window shown on the right of the elevation the kitchen window or the bathroom window?
f) What is between the back door and the bathroom window?
g) Looking south, where is the living room?
h) Which room is to the left of the bathroom and adjacent to the living room?
i) What is under the bathroom window?
j) Where do flue gases come out of the chimney stack?
k) What is at the bottom of the chimney stack?

l) What are on either side of the windows?
m) What is on the left-hand side of the living room?
n) What extends beyond the top of the roof?
o) Which rooms are in front of the bedroom?
p) What is in the centre of the chimney stack?
q) Which room is behind the kitchen?
r) What runs along the edge of the roof?
s) Where is the down pipe?

7. Study these plans of a two-storey house:



First floor plan



Ground floor plan

Now say whether these statements are true or false. Correct the false statements.

a) The dining room is located under the main bedroom.
b) A hall is located in the centre of the first floor.
c) There are three adjacent bathrooms on the first floor.
d) There is a toilet between the kitchen and the dining room.
e) Bedroom 2 is situated over the family room.
f) There is a cupboard under the stairs.
g) Bedrooms occupy most of the ground floor.
h) Viewed from the front, the dining room is on the left of the entrance.
i) Viewed from the rear, the living room is behind the family room.
j) Entering the house from the garage, you pass through the living room to enter the family room.
k) The entrance is situated at the bottom of the stairs.
l) The kitchen and family room are located on either side of the toilet.
m) A door in the garage leads to the kitchen.

8. Say where these rooms are in relation to each other:

a) kitchen – dining room
b) bathroom 1 – kitchen
c) cupboard – bedroom 2, bedroom 3

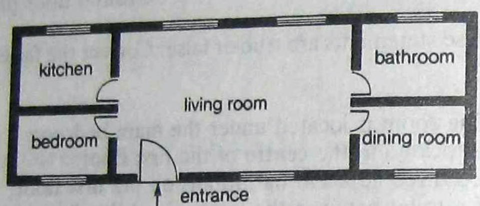
9. Read this:

When the architect designed the house, he placed the bedrooms away from the living room (A). He also placed the kitchen next to the dining room (B) and the bathrooms near the bedrooms (C). On the outside of the house he placed a covered porch over the entrance (D).

Each of the following sentences will fit into one of the spaces in the above passage which are marked by the letters A, B, C, D. Match the sentences with these letters.

a) because people need to wash before going to bed
b) because people waiting to enter the house need protecting from the weather
c) because the noise from the living room will disturb people sleeping
d) because it makes serving food easier

10. Look at this plan for a single-storey house:



Now read this discussion between an architect and his client:

CLIENT: I don't like this plan because the dining room and the kitchen are on opposite sides of the house.
ARCHITECT: So what!
CLIENT: Well, it is a long way to carry the food.
ARCHITECT: Does that matter very much?
CLIENT: Yes. I think it does, because the food will get cold on its way from the kitchen to the dining room.

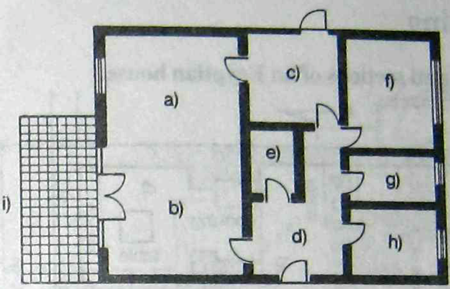
Make similar discussions between the architect and his client complaining about:

a) the relative position of the bathroom and bedroom
b) the relative position of the bedroom and living room
c) the lack of a covered porch over the entrance

Section 3 Reading

11. Read this description of House A:

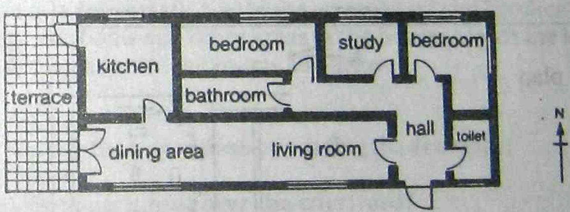
The house is a single-storey building with a square-shaped plan. It contains seven rooms. The entrance which is located on the south side leads into a hall. On the left of the hall is the living room and beyond that in the north-west corner is the dining area. The kitchen is adjacent to the dining area. A terrace is situated outside the living room on the west side. A toilet is located in the centre of the house. Access to the toilet is from the hall. The two bedrooms are located on the east side with a bathroom between them. There is also an entrance to the kitchen on the north side.



Plan of House A

Match the letters with the names of the areas.

12. Now write a description of House B.



Plan of House B

13. Say whether these statements are true of House A, House B or both. Then make statements comparing the two houses.

Example: This house contains eight rooms.
Answer: House B.

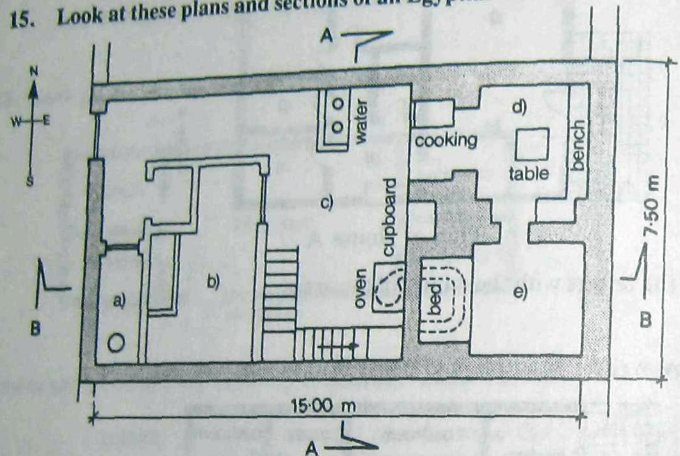
House A contains seven rooms whereas House B contains eight rooms.

a) The front door of this house opens inwards.
b) The toilet is located in the south-east corner of the house.
c) The terrace extends the whole length of the western wall.
d) It has a longer and narrower shaped plan.
e) The kitchen door opens outwards.
f) The bathroom has a window.
g) This house has a study.
h) It does not have a separate dining room.
i) The windows of the living room face west.
j) The kitchen window faces north.

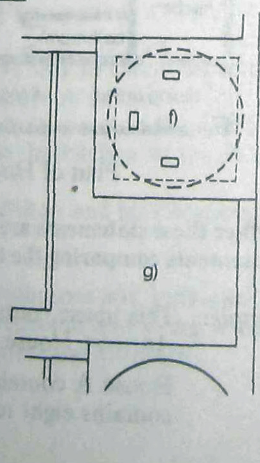
14. Now design a single-storey house and compare your plan with House A.

Section 4 Listening

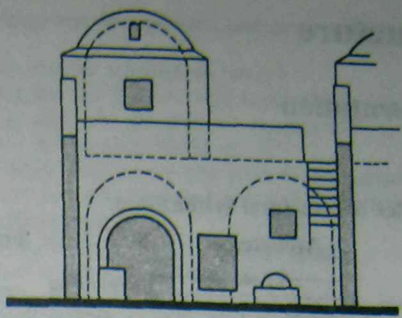
15. Look at these plans and sections of an Egyptian house:



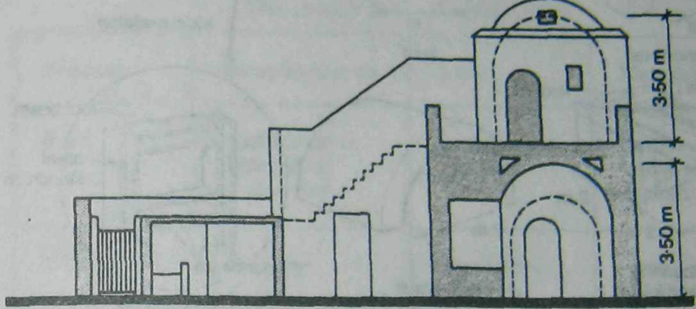
Ground floor plan



First floor (roof) plan



Section A–A



Section B–B

Now listen to a conversation between an architect and his client about the location of rooms and other areas in the house. Match the letters a)–g) with the names of the rooms and areas.

16. Now answer these questions by reading the drawings:

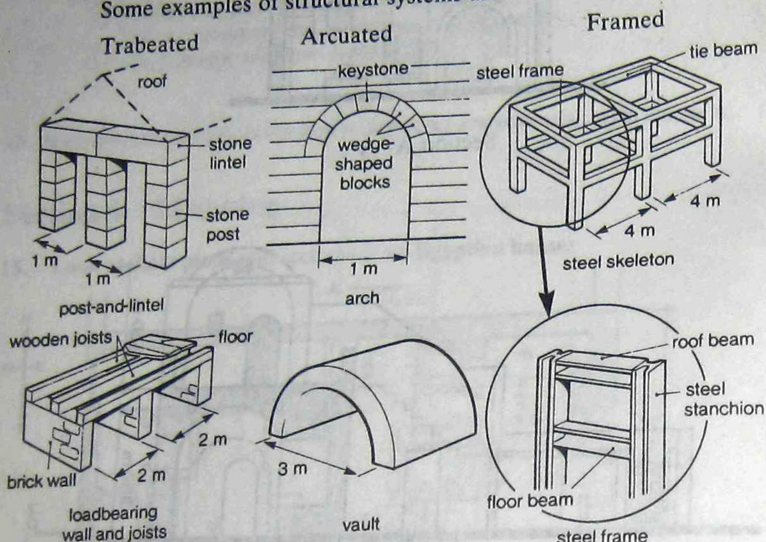
a) Is there a roof over the courtyard?
b) Is there a roof over the stable?
c) In which wall is the door to the first floor bedroom located?
d) What type of construction is used for the house? (mass, planar or frame)
e) What is the shape of the roof over the winter bedroom?
f) Why are there no windows in the two longest walls of the house?

Unit 3 Structure

Section 1 Presentation

1. Look and read:

Some examples of structural systems are:



The post-and-lintel structure *consists of* three upright posts and two horizontal lintels.

The posts { *support* / *carry* } the lintels which { *carry* / *support* } the roof.

The lintels *span* a distance of 1 metre.
Materials used for post-and-lintel structures *include* stone and timber.

Now make similar statements about the loadbearing wall and joist structure.

2. Read this:

The post-and-lintel structure, in the diagram above, *is composed of* straight members. The vertical and horizontal members which are used to make the structure *are called* posts and lintels respectively. The posts *are spaced at* 1 metre centres. They *are made up of* blocks. Both the posts and the lintels *are made of* stone.

Now write a similar description of the loadbearing wall and joist structure.

3. Look at the diagrams in exercise 1 and answer these questions:

a) What do the stanchions carry?
b) What do the floor beams support?
c) What does the steel frame consist of?
d) What is the arch made up of?
e) At what centres are the steel frames spaced?
f) What are the horizontal members which connect steel frames together called?
g) What distance does the vault span?
h) What is the span of the arch?
i) What is the stone in the centre of the arch called?
j) Give some examples of materials used for arcuated and framed structures.

4. Look at this table:

The components of a factory

Elements	Compound units	Units	Materials
Roof	roof structure waterproof covering	joists and slabs	timber wood-wool asphalt
Walls	cladding wall structure	corrugated sheets beams and stanchions	steel steel
Floors	wearing surface floor structure	tiles panels	vinyl precast concrete
Foundations		column bases	concrete

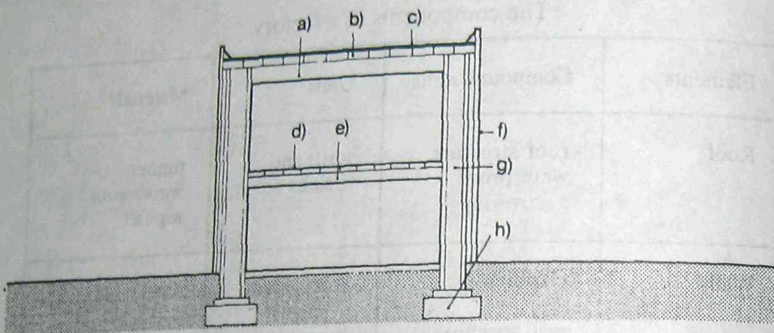
Now make questions and answers using this table and the table above:

a)	What $\left\{\begin{array}{l}\text{does}\\ \text{do}\end{array}\right\}$ the $\left\{\begin{array}{l}\text{roof}\\ \text{walls}\\ \text{floors}\end{array}\right\}$ consist of?
b)	How many $\left\{\begin{array}{l}\text{elements}\\ \text{compound units}\end{array}\right\}$ is the $\left\{\begin{array}{l}\text{factory}\\ \text{wall}\\ \text{roof}\end{array}\right\}$ constructed from?

c) What is the {roof structure / wall structure / floor structure} made up of?
d) What are the {joists / corrugated sheets / precast panels} made of?

5. Look at this section through a factory and label the components using the first table in exercise 4:

Example: a) timber joists



6. Now complete this passage:

The factory ...... from four elements: the _______, the _______, the _______, and the _______. The roof ...... a waterproof covering, which is made of _______, and a ......, which is made of timber joists and _______ slabs. The walls are constructed from two ......, the wall structure, which consists of ......, and the _______, which is made of...... sheets. The _______ consists of a wearing surface, which is made of ...... and a floor structure, which is made of ...... The foundations consist of .....

7. Answer these questions by giving properties of materials:

a) Why is steel used for the frame structure of the factory?
b) Why is asphalt used for the waterproof covering?
c) Why are corrugated steel sheets used for the cladding?
d) Why are vinyl tiles used for the wearing surface?
e) Why is concrete used for the column bases?

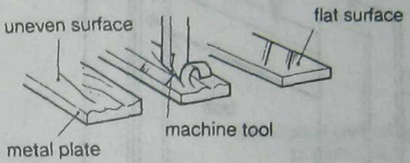
8. **Now make tables like this analysing the structures of several different buildings found in your country. Use the following headings:**

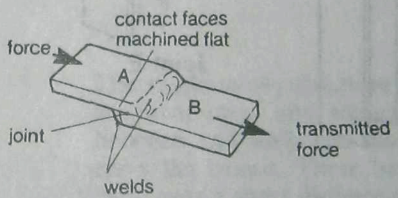
Structural system	Elements	Compound units	Units	Materials

Compare the structures of the buildings and the properties of the materials used to make them.

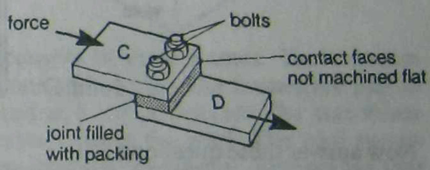
Section 2 Development

9. **Look and read:**





Joint X

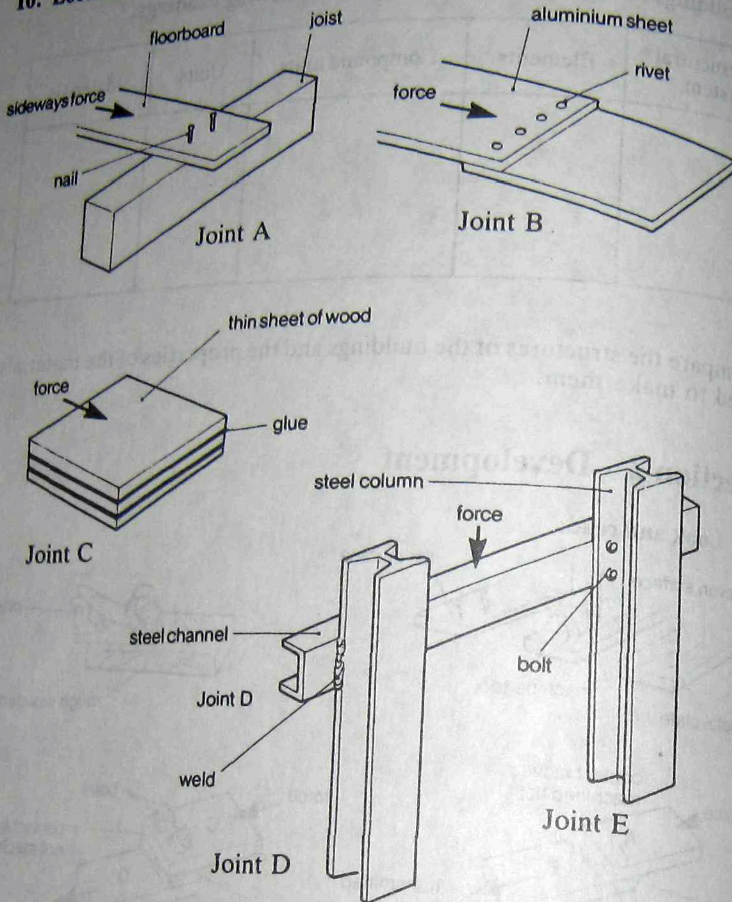


Joint Y

Joint X
Plate A *is welded to* plate B.
Plate A *is joined to* plate B by welds.
Plates A and B *are welded together.*
The force on plate A *is transmitted through* the welds to plate B.
Joint X *is* not *filled with* packing because the contact faces of the joint are machined flat.

Now complete these sentences about Joint Y:
a) Plate C ...... plate D by ......
b) Plates C and D ......
c) The force on plate C ......
d) Plate C ...... plate D.
e) Joint Y is filled with packing ......

10. Look at these diagrams of joints:



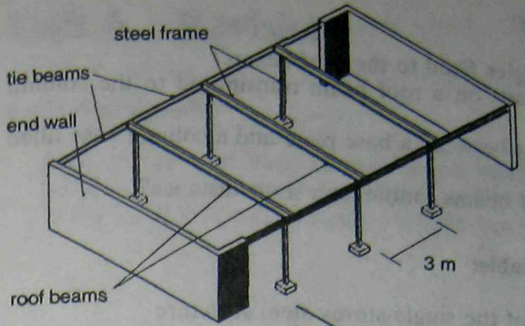
Now answer these questions:

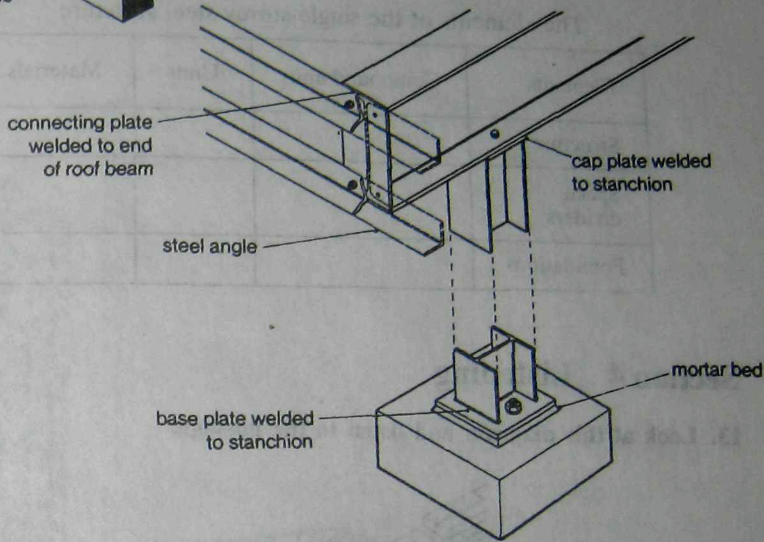
a) For each joint, say how the units are joined together.
b) Explain how forces are transmitted through each joint.
c) In which joints can packing be used?
d) In which joints should the joint surfaces be machined flat?

Section 3 Reading

11. Look and read:

In the following diagram showing the layout of frames the span of beams is 9 metres.
The frames *are spaced at 3 metre centres*.





The single-storey structure consists of three frames. These frames are made up of steel stanchions and beams. The frames are placed between end walls and spaced at 3 metre centres. The stanchions carry the beams. These beams support the roof. The roof beams cantilever a short distance beyond the stanchions. This means that they extend over the profiled sheet steel cladding. The cladding can then be placed outside the line of the stanchions.

The beams are bolted to steel stanchion caps. The stanchion caps are welded to the top of each stanchion. The load on each beam is transmitted through these plates to the stanchions.

The upper face of the steel base plates and the ends of the stanchions are machined flat. The bottom of each stanchion is welded to a base plate. Each base plate is fixed to a concrete column base by two holding-down bolts.

Steel angles are fixed across the ends of the beams and built into the brick walls. These angles tie the frames together and also provide a place to fix the top of the cladding.

Now answer these questions:

a) How are the angles fixed to the roof beams?
b) How are the loads on a roof beam transmitted to the column bases?
c) What is the joint between a base plate and a column base filled with?
d) Why do the roof beams cantilever a short distance?

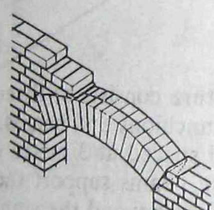
12. Copy and complete this table:

The elements of the single-storey steel structure

Elements	Compound units	Units	Materials
Structure			
Space dividers			
Foundations			

Section 4 Listening

13. Look at this diagram and listen to the passage:



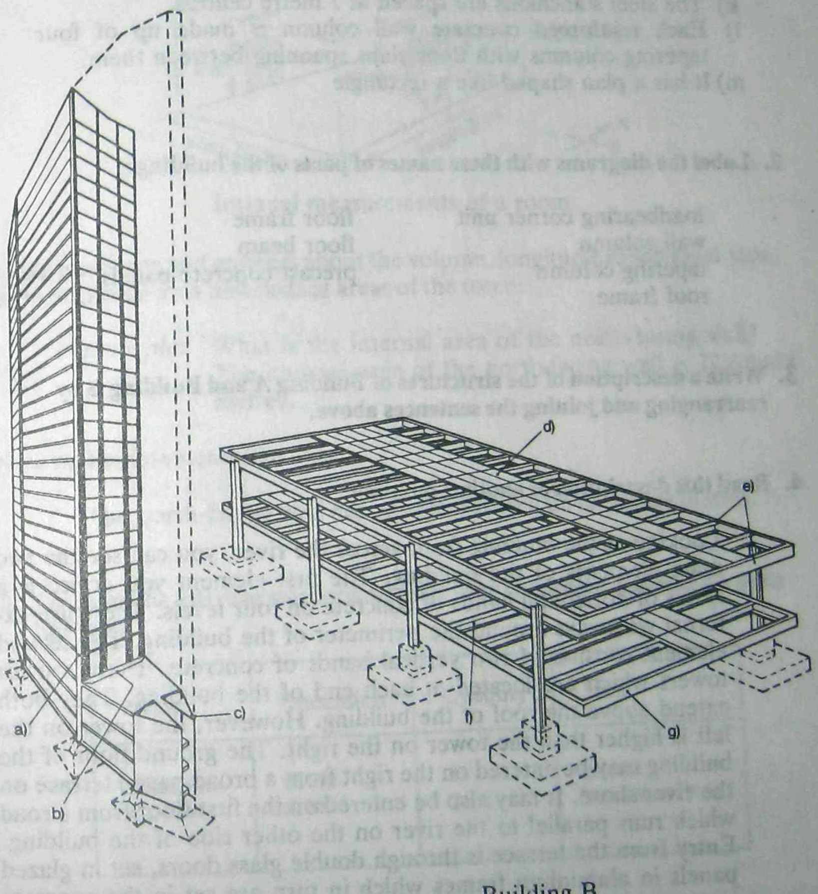
Now copy and complete these notes:

Name of structure: _______ arch
Reason for name: shaped like _______ of _______
Advantage of structure: can use components _______ than _______ of opening
Shape of components: _______
Reason for shape: bricks _______ each other
Name of last brick: _______
Position of joints: between _______ at _______
Materials of mortar: _______ to curve
Type of forces in arch: _______ and _______
If tensile forces: _______ arch will _______ _______

Unit A Revision

1. Look and read:

Look at these drawings of two famous buildings. Building A is located in Italy and was designed by Gio Ponti; Building B is located in the USA and was designed by Mies van der Rohe.



Building A

Building B

Now say which building each of these sentences refers to:

a) The roof and floor frames are made up of I-shaped beams and channels.
b) The building has 30 storeys above ground and 3 basement levels.
c) The skeleton structure is made of reinforced concrete.
d) The roof and floor frames are supported by steel stanchions.
e) Its plan is roughly hexagonal in shape.
f) The roof and the floor consist of precast concrete panels.
g) The building has one storey which is raised above ground level.
h) The structure consists of four triangular-shaped loadbearing corner units and two wall columns between them.
i) The skeleton structure is made of welded steel.
j) The precast concrete panels span between the beams.
k) The steel stanchions are spaced at 7 metre centres.
l) Each reinforced concrete wall column is made up of four tapering columns with floor slabs spanning between them.
m) It has a plan shaped like a rectangle

2. Label the diagrams with these names of parts of the buildings:

loadbearing corner unit
wall column
tapering column
roof frame
floor frame
floor beam
precast concrete panels

3. Write a description of the structures of Building A and Building B by rearranging and joining the sentences above.

4. Read this description of another building:

Looking at the building from across the river, you can see the two main elements of the building. The first element you notice is a series of horizontal bands of concrete on four levels. These are external walkways around the perimeter of the building. The second element consists of two vertical bands of concrete. These are lift towers which are located at each end of the building. They both extend above the roof of the building. However, the tower on the left is higher than the tower on the right. The ground floor of the building may be entered on the right from a broad paved terrace on the river shore. It may also be entered on the first floor from a road which runs parallel to the river on the other side of the building. Entry from the terrace is through double glass doors, set in glazed panels in aluminium frames which in turn are set in the concrete structural elements.

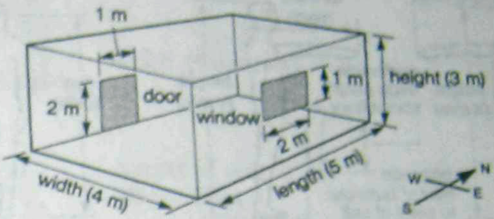
Now draw a diagram of the elevation of the building as seen from across the river, and a diagram of the entrance doors.

Unit 4 Measurement 1

Section 1 Presentation

1. Look and read:

A room has three spatial dimensions: length, height and width. These dimensions are measured in millimetres or metres. The volume of a room equals length times height times width. Volume is measured in cubic metres (m^3). The area of a surface in the room is measured in square metres (m^2).



Internal measurements of a room

Make questions and answers about the volume, longitudinal-sectional area, cross-sectional area and surface areas of the room:

Example: What is the internal area of the north-facing wall? The internal area of the north-facing wall *is* 12 square metres.

Now make statements like this:

The north-facing wall *has* an internal area of 12 square metres.

2. Estimate the internal measurements of your classroom and make a table like this:

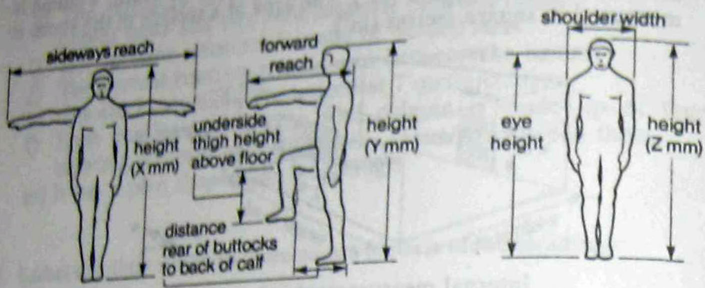
Name	Dimension	Quantity	Unit
classroom window *etc.*	width area	4 2	metre square metres

Now from your table make sentences like the following:

The classroom *has* a *width* of approximately 4 metres.
The classroom *is* approximately 4 metres *wide*.

The window *has* an *area* of approximately 2 square metres.
The window *is* approximately 2 square metres *in area*.

3. Look and read:



In a group of three people, their height {*varies between* / *ranges from*} X {*and* / *to*} Z mm. The maximum height is Z mm and the minimum is X mm. The average height in this group is therefore $\left\{\frac{X+Y+Z}{3}\right\}$ = W mm.

Now make a table of the following measurements of each person in your group and then write three similar paragraphs:

Anthropometric data

	Height in mm	Eye height in mm	Forward reach in mm	Shoulder width in mm	Length of lower leg in mm	Length of upper leg in mm
Student 1 Student 2 Student 3 etc.						

4. Look and read:

When designing a building for a group of people, an architect considers the maximum, minimum and average dimensions of their bodies. For each design situation shown below say which dimension an architect should base his calculations on:

Design situation		Dimension
	*Example:* floor-to-ceiling height	maximum height in the group (tallest person)
a) 	width of doorway	......
b) 	height of seat above floor	......
c) 	height of notices	......
d) 	length of seat surface from backrest to front edge	......
e) 	width of sink unit	......

5. Use the measurements you collected in exercise 3 to help you complete this paragraph:

When deciding on the floor-to-ceiling height of a building, an architect should base his calculations on the tallest person in a group of people. The tallest person in our group is _______ mm. Therefore the floor-to-ceiling height of our building should be greater than _______ mm.

Now write similar paragraphs about two other design situations.

6. **Explain the following facts:**

a) The tables used in infant schools are lower than the ones used in universities.
b) More people can be carried on a train during rush hour in summer than in winter.
c) An African will be uncomfortable sitting in a chair designed for a Japanese.
d) The doorway height in Britain is usually 2 100 mm although some Britons are taller than 2 100 mm.

7. **Design a table and chair using data from exercise 3, page 46.**

Section 2 Development

8. **Look and read:**

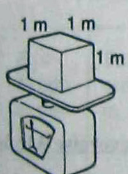
Common measurements in architecture

Units of measurement

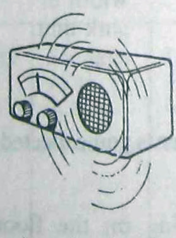
Unit symbol	SI unit	Unit symbol	SI unit
lm lx °C kg J s	lumen lux (1 lumen/m^2) degree Celsius kilogramme joule second	kg/m^3 N/mm^2 dB A	kilogramme per cubic metre newton per square millimetre decibel ampere

Say which unit is used to measure these dimensions:

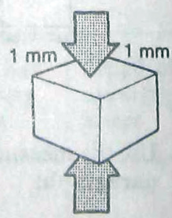
a) mass



b) density (mass per cubic metre)



c) noise level



d) stress (force per square millimetre)

e) illumination (light falling on surface)

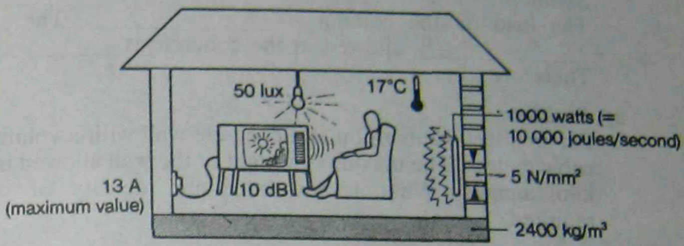
f) luminous flux (flow of light measured in lumens)

g) electric current

h) temperature

i) heat

9. Look at this diagram and complete the sentences below:



a) The temperature of the room is measured in ______ ______
b) The ______ in the concrete block is 5 N/mm^2.
c) The noise level of the television is measured in ______.
d) The illumination in the room is measured in ______.
e) The ______ of the concrete foundation is 2 400 kg/m^3.
f) The electric current to the television is measured in ______.
g) The ______ from the light bulb is 50 lux.
h) The heat flow rate of the radiator is measured in ______.

10. Now make a list of some of the things in your classroom that can be measured. Say what they are and what units they are measured in.

11. Read this:

The performance requirements of a building are expressed in this way:

The area of the room *should be* 40 m^2.

For maximum requirements:

The area of the room *should not be greater than* 50 m^2.

For minimum requirements:

The area of the room *should not be less than* 30 m^2.

Now read these problems and complete the solutions:

a) *Problem*
A family of 5 persons want to build a house. The floor area allowed for each person is 10 square metres. What is the floor area required?

Solution
There are ______ people. The floor area allowed per person is ______ ______. Therefore ...... ______ ______ ______ .

b) *Problem*
An architect wants to build a concrete column to take a compressive force of 2 000 newtons. The maximum compressive stress allowed in the concrete is 5 N/mm^2. What is the minimum cross-sectional area of the column required?

Solution
The load on the column is ______ ______. The ______ ______ ______ allowed in the concrete is ______ ______.
Therefore ......

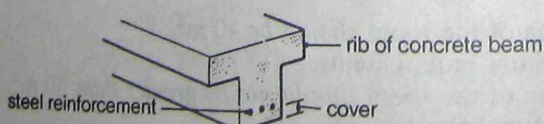
c) *Problem*
An architect wants to build a concrete wall with a volume of 10 cubic metres. The maximum weight of the wall allowed is 22 000 kilogrammes. What is the maximum density of concrete required?

Solution
The volume ......

Section 3 Reading

12. Read this passage:

Concrete is made from cement, coarse aggregate (stones), fine aggregate (sand or crushed stone) and water. Coarse aggregate ranging from 5 mm to 40 mm may be used for normal work. The maximum size of the aggregate should not be greater than one quarter of the minimum thickness of the finished concrete. The normal maximum sizes are 20 mm and 40 mm (20 mm being more common. The maximum size of aggregate which should be used in small concrete sections, or where reinforcement is close together, is 10 mm.



Reinforced concrete section

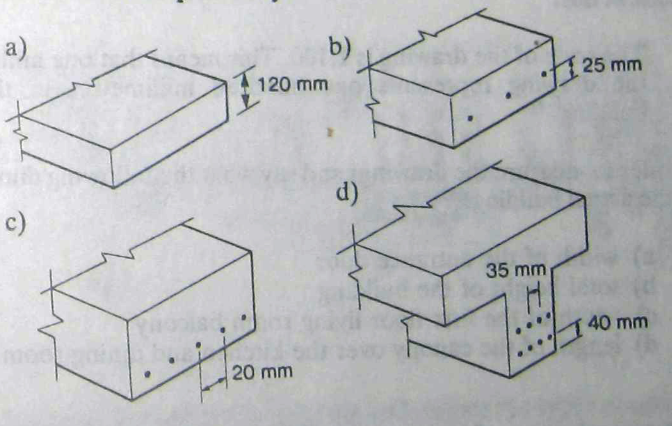
In concrete with widely spaced reinforcement, such as solid slabs, the size of the coarse aggregate should not be greater than the minimum cover to the reinforcement otherwise spalling will occur, i.e. the breaking off of pieces of concrete below the reinforcement. For heavily reinforced sections, e.g. the ribs of main beams, the maximum size of the coarse aggregate should be either:

(i) 5 mm less than the minimum horizontal distance between the reinforcing rods, or,
(ii) 5 mm less than the minimum cover to the reinforcement, whichever is the smaller.

Now say whether these statements are true or false. Correct the false statements.

a) Concrete is made from three different materials.
b) Coarse aggregate ranges in size from 20 mm to 40 mm.
c) When the minimum thickness of the finished concrete is 100 mm, the maximum size of aggregate should not be greater than 25 mm.
d) When the reinforcing rods are close together, the maximum size of aggregate used should be 10 mm.
e) Cover is the thickness of concrete between the reinforcing rods.
f) The reinforcing rods are placed near the bottom of the rib of a concrete beam.
g) Spalling can occur in a solid concrete slab when the cover to the reinforcement is greater than the maximum size of the coarse aggregate.
h) When the minimum horizontal distance between reinforcing rods is 15 mm, the maximum size of aggregate should be less than 12 mm.

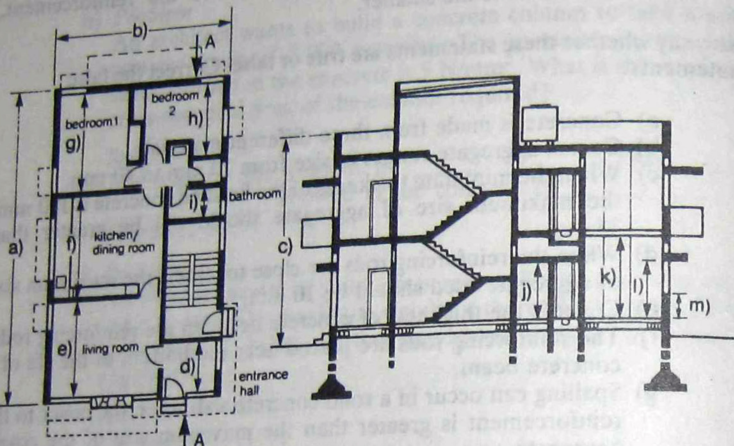
13. Look at these drawings. What is the maximum size of aggregate that should be used? Explain why.



Section 4 Listening

14. Look and listen:

Study these drawings of a residential building. Listen to a discussion between two workmen about the dimensions of the building and make notes about the dimensions marked a)–m) on the drawings.



Ground floor plan

Section A–A

Now make statements like this:

a) The external length of the building is 12 500 mm

15. Look at this:

The scale of the drawing is 1:100. This means that one millimetre on the drawing represents one hundred millimetres in the actual building.

Use a ruler to measure the drawings and say what the following dimensions are in the actual building:

a) width of the entrance door
b) total height of the building
c) width of the first floor living room balcony
d) length of the canopy over the kitchen and dining room window.

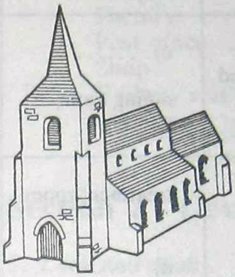
16. Using graph paper, draw the front elevation of the building to a scale of 1:100.

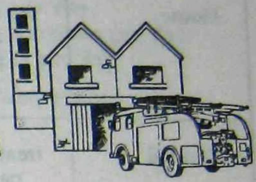
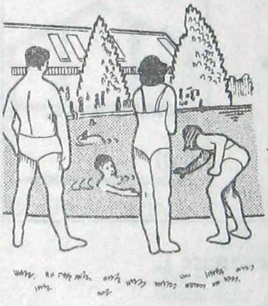
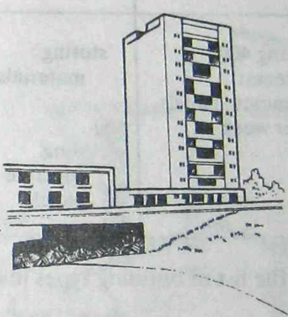
Unit 5 Process 1 Function and Ability

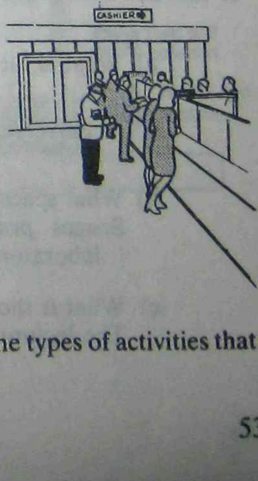
Section 1 Presentation

1. From the list of types of buildings, try to label the drawings below:

block of flats
hotel
hospital
fire station
school
church
railway station
swimming pool
bank



Now say what each building is used for and discuss the types of activities that could go on in each building.

2. Look at this table and complete the examples:

Building type	Purpose of building	Examples of activities	Spaces provided
University	educating 200 students per year	giving lectures a) ...... storing and reading books	lecture room laboratory b) ______
House	accommodating a family of 5 persons	preparing and cooking food c) ...... d) ______	e) ...... dining room bedroom
Hospital	treating 150 patients per day	f) ...... examining patients g)	treatment room h) ...... dispensary
Factory	making 400 precast concrete panels per week	storing materials i) ...... casting concrete panels	j) ...... mixing space k) ......

Now add examples from the list of building types in exercise 1.

3. Ask and answer questions like the following:

a) What is the *function* of a university?

A university { *functions* / *serves* } as a place for educating students.

b) What spaces *are provided* in the building?
Spaces *provided* in the building include a lecture room, laboratories and a library.

c) What *is* the lecture room *used for*?
The lecture room *is used for* giving lectures.

4. Look at this example:

The university { *has the capacity to educate* / *is capable of educating* } 200 students a year.

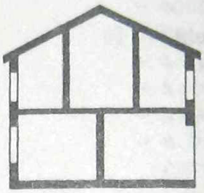
Now match the building type on the left with the phrase on the right to make similar sentences:

House	make 400 precast panels per week.
Hospital	accommodating a family of five persons.
Factory	serving up to 200 customers per day.
Post office	treat up to 150 patients per day.
Shop	dealing with 10 train movements per day.
Railway station	handle up to 1 000 letters per day.

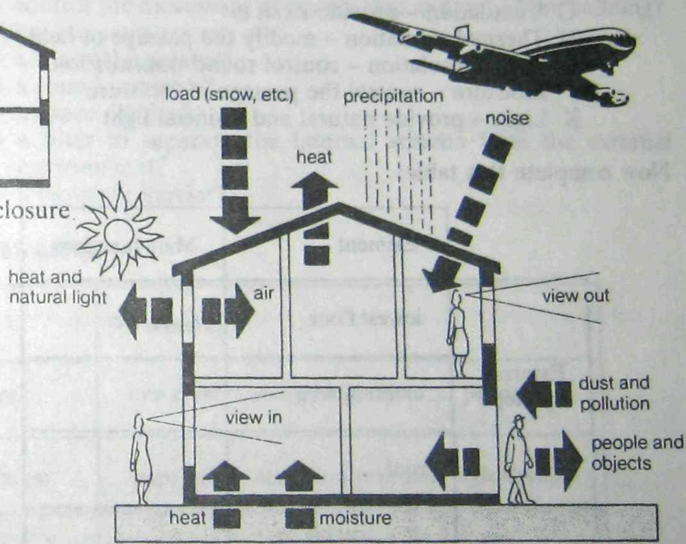
Add other examples from your list of building types.

Section 2 Development

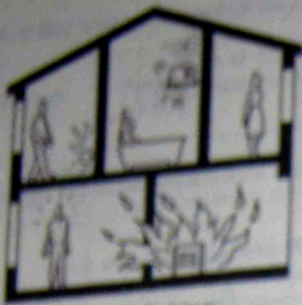
5. Look and read:



Building enclosure



External envelope



Internal division

Buildings are designed so they are capable of performing the design requirements. The most important design requirements include the following:

A Weather resistance – keep out wind, dust and precipitation
B Privacy – provide visual screening
C Surfaces – provide surfaces for activities
D Security – keep out intruders
E Fire resistance – prevent fire from spreading
F Structure – resist loads
G Ventilation – provide fresh air
H Thermal insulation – modify the passage of heat
I Sound insulation – control sound transmission
J Moisture – control the passage of moisture
K Light – provide natural and artificial light

Now complete this table:

	Element	Main functions
External envelope	lowest floor	C, H, *etc.*
	external wall	
	roof	
Internal division	suspended floor	
	partitions	
	suspended ceiling	

Use the table to make statements like the following:

> The functions of the lowest floor include providing surfaces for activities and modifying the passage of heat.

6. Look at these examples:

> The external wall acts as a thermal insulator.
> The roof and the external walls *are designed* to resist loads.
> The partition *enables* the building to provide visual screening.

Now answer these questions:

a) What enables the occupants of a building
- to keep dry?
- to have privacy?
- to keep warm?
- to be safe from fire?
- to read during the nighttime?
- to be safe from intruders?

b) What element is designed to
- control the noise level between rooms?
- support snow loads?
- resist the passage of moisture?
- let in natural light?
- control the movement of people into and out of the building?

c) What elements act as
- a thermal insulator?
- a sound insulator?
- a space divider?
- a filter to separate the internal volume from the external environment?
- a moisture barrier?

7. Look at this table:

Name	Properties
Concrete	low combustibility, high density, pervious
Aluminium	impervious, corrosion resistant, high strength
Steel	high strength, high thermal conductivity
Mineral wool	low thermal conductivity, low strength
Ceramic tile	hard, impervious, good appearance

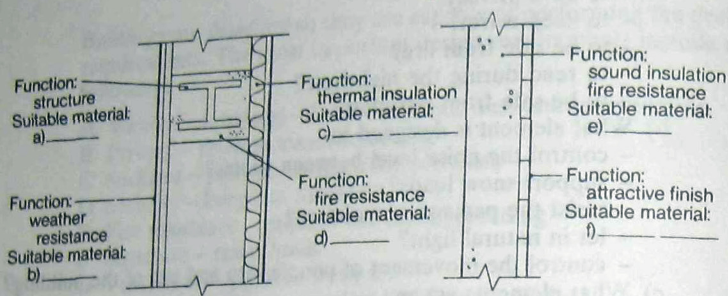
Look at this example:

An impervious material { *has the ability to keep out* / *is able to keep out* / *is capable of keeping out* } water.

Now make statements about the materials in the table. For example:

Concrete is capable of withstanding high temperatures.

8. Look at these sections through walls and complete the labels:



Now write four sentences like this example:

Concrete has low combustibility and is therefore used to provide fire resistance for walls.

9. Look again at the diagrams in exercise 5, page 55. Choose a suitable material for each element and say why you have chosen that material.

Section 3 Reading

10. Read this passage:

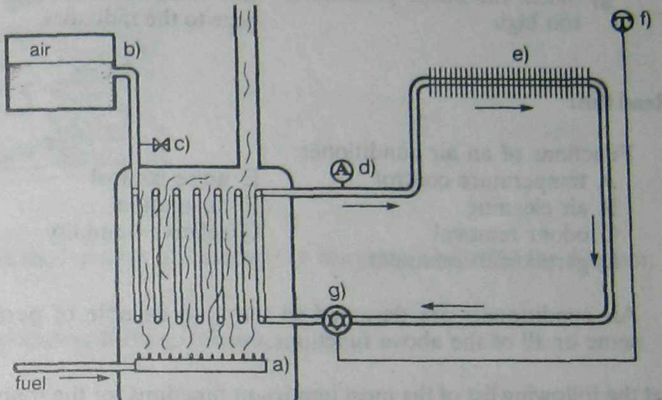
One method of heating a building is to circulate hot water through radiators which are located in each room. The water is heated in a boiler by a burner and is kept at a constant temperature by a thermostat device called an aquastat. The aquastat is located on the outlet pipe from the boiler. The pipe runs in a continuous loop from the boiler to the radiators and back to the boiler. The function of a radiator is to transfer the heat from the hot water to the air in the room. Therefore they are made of a material which has the property

of high thermal conductivity. The shape of the radiator is also important because the greater the surface area the more rapidly it gives off heat. One type of radiator, called a fin tube, consists of a number of thin fins shaped like a circle which are welded to a pipe passing through their centres.

A thermostat in the room can be set to the required temperature. When the air temperature in the room decreases, the thermostat switches on the pump which is located on the return line from the radiators. When the room reaches the set temperature, the thermostat switches off the pump.

An expansion tank is provided to allow for expansion of the water as it heats. A safety valve, located on the pipe leading to this tank, serves to relieve the pressure in the boiler if it is too high.

Now look at the diagram and match the letters with the parts of the heating system:



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11. Answer these questions:

a) What enables the inside of a building to be kept warm?
b) Which part of the heating system circulates hot water through the continuous pipe?
c) Which part acts as the room temperature controller?
d) Which part functions as a means of controlling the temperature of the water in the boiler?
e) Which part is designed to transfer the heat from the hot water to the air in the room?
f) Which part prevents the boiler from blowing up?
g) Which part serves as a device for heating the water in the boiler?
h) Which part enables the water to expand safely?

12. Make true statements by matching these halves of sentences:

a) When the pump is switched on	the aquastat shuts down the burner.
b) When the temperature of the water in the boiler decreases	the safety valve relieves the pressure.
c) When the temperature of the water in the boiler reaches the set temperature	the thermostat switches on the burner.
d) When the air temperature decreases	it flows into the expansion tank.
e) When the radiator is turned on	the aquastat starts up the burner.
f) When the water in the boiler expands	heat is transferred from the hot water to the air in the room.
g) When the boiler pressure is too high	hot water flows through the pipe to the radiators.

13. Read this:

Functions of an air conditioner:

A temperature control
B air cleaning
C odour removal
D germicidal treatment
E noise control
F air motion
G relative humidity

Air conditioners are designed so they are capable of performing some or all of the above functions.

Look at the following list of the most important functions for the following spaces, and make statements like the example below:

Auditoria	A C E
Commercial offices	C B F
Apartments	A C E
School classrooms	A C D
Motels	A E C

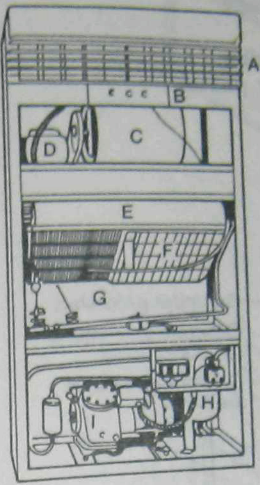
Example: In an auditorium, the three most important functions of an air conditioner are to control the temperature, to remove odour and to control noise.

Now make similar statements about what you think to be the three most important functions of an air conditioner for the following spaces and discuss the reasons for your choice:

Hospital patients' rooms
Factory buildings
Computer rooms
Medical buildings
Hotel guests' rooms

Section 4 Listening

14. Look at the diagram of a packaged air conditioning unit. Listen to a lecturer explaining to a class of students how it works:



A four-way adjustable louvre
B thermostat control and OFF-AIR-COOL switch
C Adjustable speed fan
D Fan motor
E Evaporator
F Air filters
G Fresh air opening at back
H Condenser
I Compressor

Describe the location and function of the parts labelled in the diagram.

15. Now answer these questions:

a) Why is it called a 'packaged air conditioning unit'?
b) Why is it located on an outside wall?
c) What are the air filters made of?
d) When should the filters be cleaned?
e) What materials are used to make the evaporator?
f) What are the cooling coils designed to do?

Unit 6 Process 2 Actions in Sequence

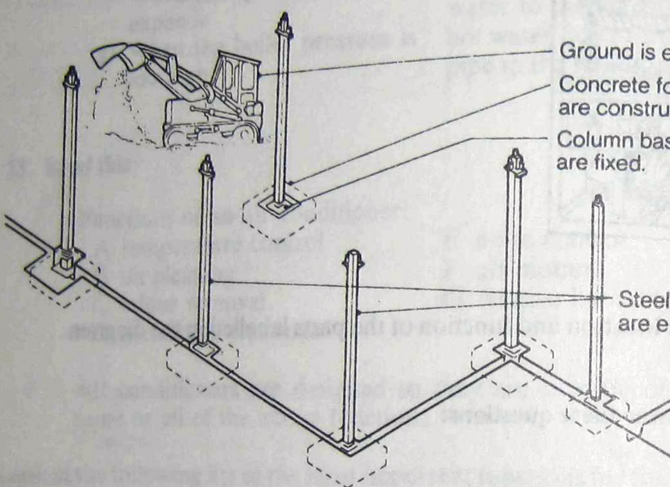
Section 1 Presentation

1. Look and read:

Assembly sequence of a prefabricated building

The sequence is divided into four stages or phases:

Phase 1



Event 1 *Initially* / *First*, the ground is excavated.

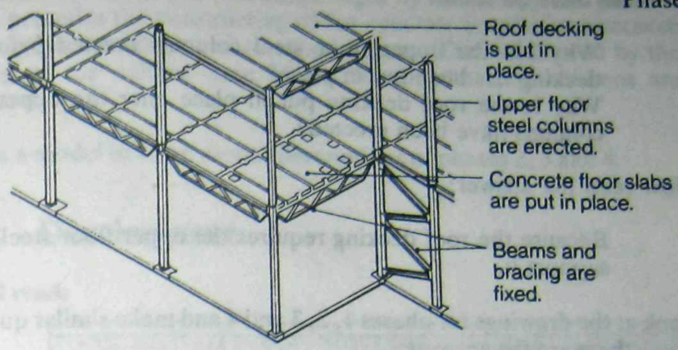
Event 2 *Then*, the concrete foundations are constructed.

Event 3 *Later* / *Subsequently*, the column base plates are fixed.

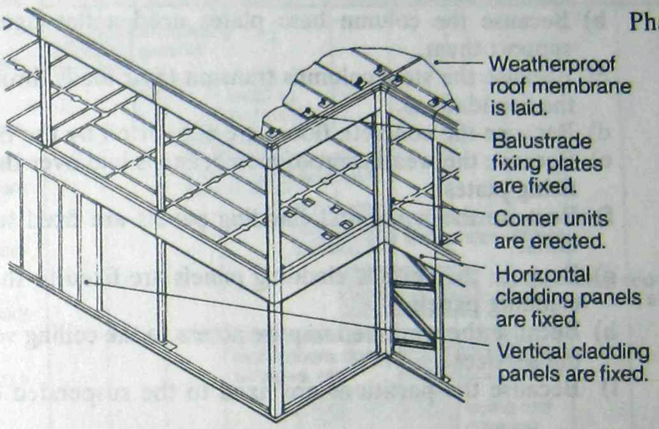
Event 4 *Finally*, the steel columns are erected.

Now look at the drawings of the next three stages and make statements about the sequence of events in phases 2, 3 and 4.

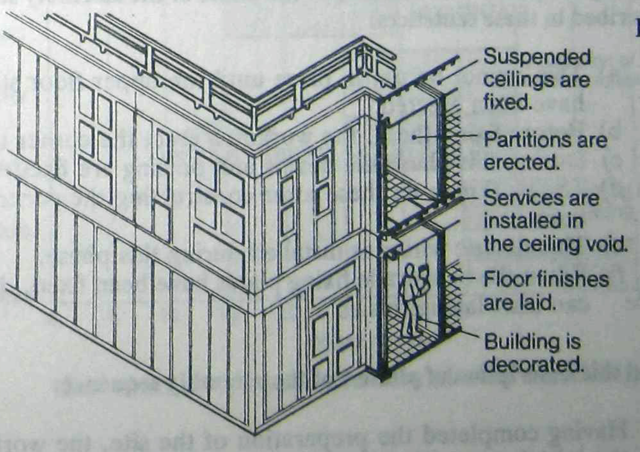
Phase 2



Phase 3



Phase 4



2. Read these questions:

Why are the upper floor steel columns erected *before* the roof decking has been put in place?
Why is the roof decking put in place *after* the upper floor steel columns have been erected?

Now read the answer:

Because the roof decking requires the upper floor steel columns to support it.

Look at the drawings for phases 1, 2, 3 and 4 and make similar questions to which these are the answers:

a) Because the concrete foundations require solid ground to support them.
b) Because the column base plates need a flat rigid surface to support them.
c) Because the steel columns transmit their loads through them to the foundations.
d) Because the concrete floors are supported by the beams.
e) Because the weatherproof membrane is laid over the balustrade fixing plates.
f) Because the horizontal cladding panels are fixed to the corner units.
g) Because the vertical cladding panels are fixed to the horizontal cladding panels.
h) Because the workmen require access to the ceiling void to install the services.
i) Because the partitions are fixed to the suspended ceilings.

3. Identify the part of the building or the phase of the assembly sequence described in these sentences:

a) This cannot be put in place until the upper floor steel columns have been erected.
b) Before fixing these, the workmen erect the corner units.
c) During this phase the beams and bracing are fixed.
d) The workmen fix these after constructing the concrete foundations.
e) The electric wiring is installed during this phase.
f) When the balustrade fixing plates have been fixed, the workmen can start laying this.

4. Read this description of phase 1 of the assembly sequence:

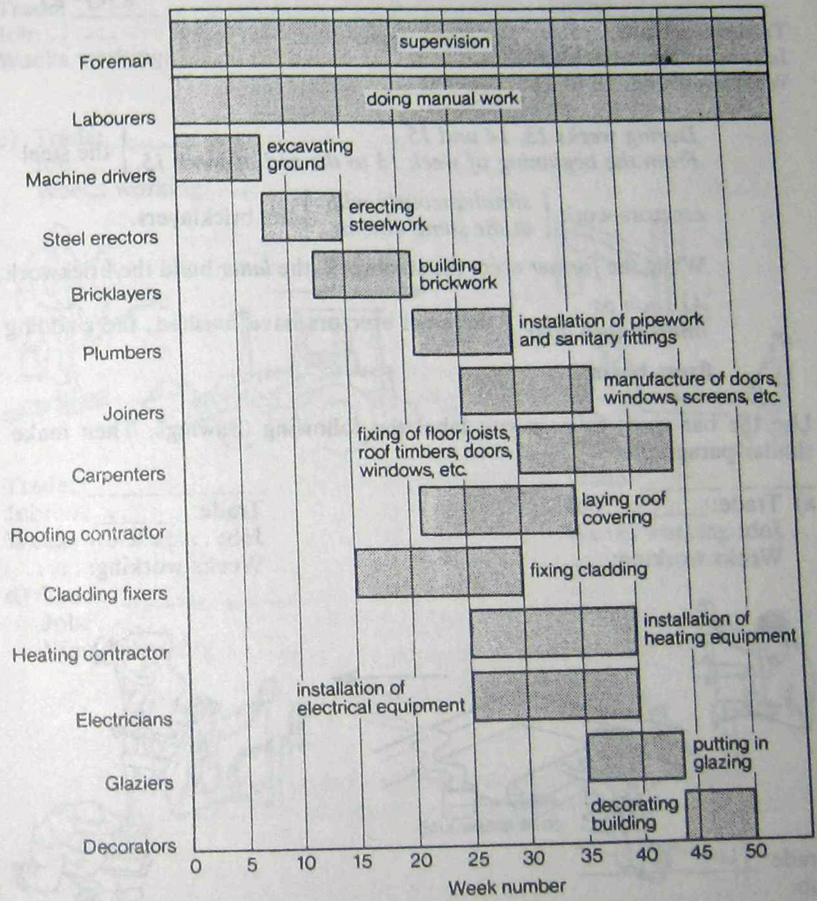
Having completed the preparation of the site, the workmen begin the initial stage. This includes excavating the ground, constructing the concrete foundations, fixing the column base plates and erecting

the steel columns. The workmen begin by excavating the ground. This precedes the constructing of the concrete foundations because they require solid ground to support them. This is followed by the fixing of the column base plates. Finally the steel columns are erected.

Now use it as a model to write similar descriptions of phases 2, 3 and 4.

Section 2 Development

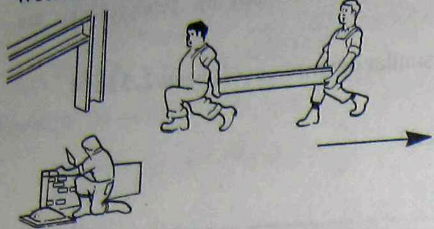
5. Look and read:

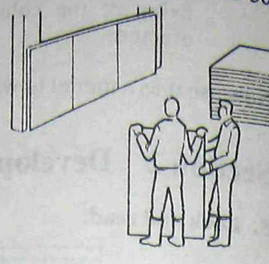


Bar chart of the sequence of trades on a building site

Trade: steel erectors
Job: erecting the steelwork
Weeks working: 9 to 15

Trade: cladding fixers
Job: fixing the cladding
Weeks working: 16 to 30





Trade: bricklayer
Job: building the brickwork
Weeks working: 13 to 21

During weeks 13, 14 and 15
From the beginning of week 13 to the end of week 15 } the steel erectors work { *simultaneously with* / *at the same time as* } the bricklayers.

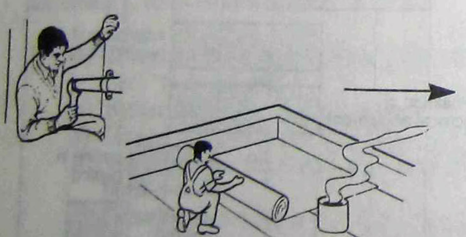
While the *former* erect the steelwork, the *latter* build the brickwork.

As soon as
Immediately after } the steel erectors have finished, the cladding fixers begin.

Use the bar chart to help you label the following drawings. Then make similar paragraphs:

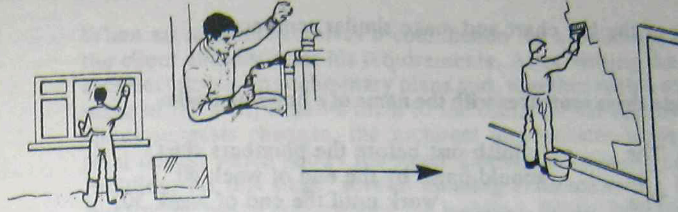
a) Trade: ______
Job: . . . . . .
Weeks working: . . . . .

Trade: ______
Job: . . . . . .
Weeks working: . . . . . .



Trade: ______ ______
Job: . . . . . .
Weeks working: . . . . . .

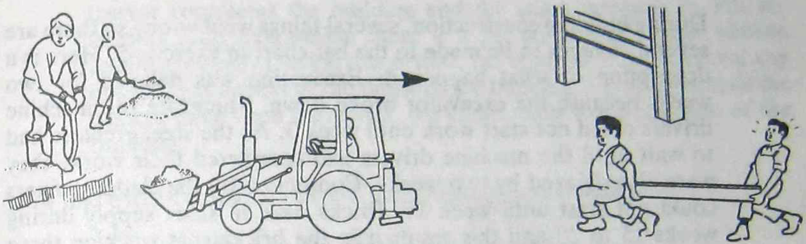
b) Trade: _______ _______
Job: . . . . . .
Weeks working: . . . . . .



Trade: _______
Job: . . . . . .
Weeks working: . . . . . .

Trade: _______
Job: . . . . . .
Weeks working: . . . . . .

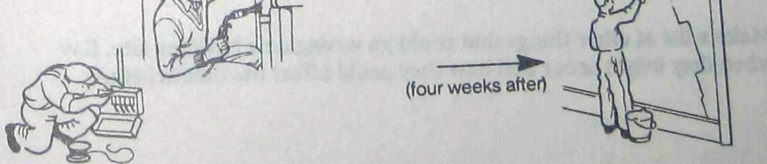
c) Trade: _______
Job: . . . . . .
Weeks working: . . . . . .



Trade: _______ _______
Job: . . . . . .
Weeks working: . . . . . .

Trade: _______ _______
Job: . . . . . .
Weeks working: . . . . . .

d) Trade: _______ _______
Job: . . . . . .
Weeks working: . . . . . .



Trade: _______
Job: . . . . . .
Weeks working: . . . . . .

Trade: _______
Job: . . . . . .
Weeks working: . . . . . .

6. Read this:

While the steelwork is being erected, some of the brickwork is built.

Now look at the bar chart and make similar sentences.

7. Complete these sentences with the name of a building trade:

a) The ______ finish just before the plumbers start.
b) The ...... should finish by the end of week 40.
c) The ______ ______ work until the end of week 30.
d) The ______ work up to the end of week 50.
e) The ______ ______ should finish no later than the end of week 8.

Now make similar sentences.

8. Read this:

During building construction, several things went wrong so there are several changes to be made to the bar chart in exercise 5. Here is a description of what happened: Excavation was delayed for two weeks because the excavator broke down. Therefore the machine drivers could not start work until week 3. As the steel erectors had to wait until the machine drivers had completed their work, they were also delayed by two weeks. Consequently, the cladding fixers could not start until week 17. Bricks were in short supply during weeks 15 to 20 and this resulted in the bricklayers working three weeks longer than expected. So the plumbers and the roofing contractor started three weeks later. In week 30 the joiners went on strike which was settled after one week. However, this meant both the carpenters and the glaziers started one week late. The wrong paint was delivered to the decorators, which delayed them by one week, but by putting on extra men the building was completed on schedule.

Now draw a new bar chart using the information in the passage.

9. Make a list of other things that could go wrong on a building site. Say when they might occur and how they could affect the time schedule.

Section 3 Reading

10. Read this:

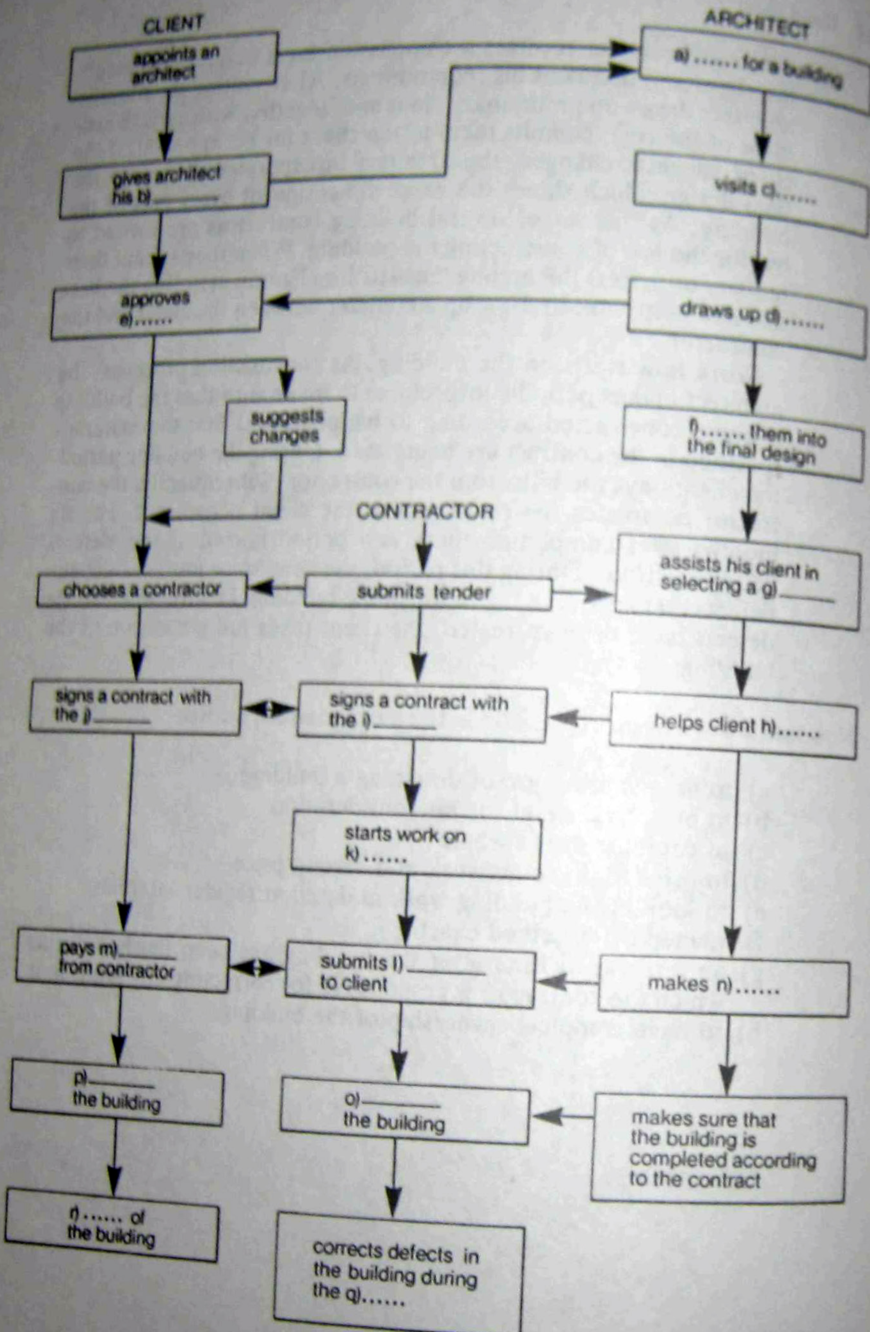
When an architect receives a commission for a building, he meets the client and discusses his requirements. After visiting the site, the architect draws up preliminary plans and, together with a rough estimate of the cost, submits them to the client for his approval. If the client suggests changes, the architect incorporates them into the final design which shows the exact dimension of every part of the building. At this stage, several building contractors are invited to bid for the job of constructing the building. When they submit their tenders or prices, the architect assists his client in selecting the best one and helps him to draw up a contract between the client and the contractor.

Work now starts on the building. As construction proceeds, the architect makes periodic inspections to make sure that the building is being constructed according to his plans and that the materials specified in the contract are being used. During the building period, the client pays the bills from the contractor. Subsequently, the contractor completes the building and the client occupies it. For six months after completion there is a period known as the 'defects liability period'. During this period, the contractor must correct any defects that appear in the fabric of the building. Finally, when all the defects have been corrected, the client takes full possession of the building.

Now find a word or an expression in the passage which means:

a) to be given the job of designing a building
b) to offer to a client for his consideration
c) to combine into a whole
d) to offer to do some work at a certain price
e) to look at the building work in detail at regular intervals
f) named or described exactly
g) an interval of time after the building has been finished during which the contractor is responsible for correcting any faults in it
h) to have complete ownership of the building

11. Complete this flow diagram:



12. **Now write three separate descriptions of the parts played in the construction of a building by the client, the contractor and the architect.**

Section 4 Listening

13. **Listen to this discussion on the application of cost control to building contracts. As you listen complete these notes:**

a) Phase 1 (______ - ______ stage)
architect submits ______ ______
client sets a ______ ______
cost limit broken down into ______ ______
architect completes ______ ______ and ______
specifications sent to ______

b) Phase 2 (______ - ______ stage)
regular checks made to compare ______ ______
with ______ ______ of ______
all information filed to help ......

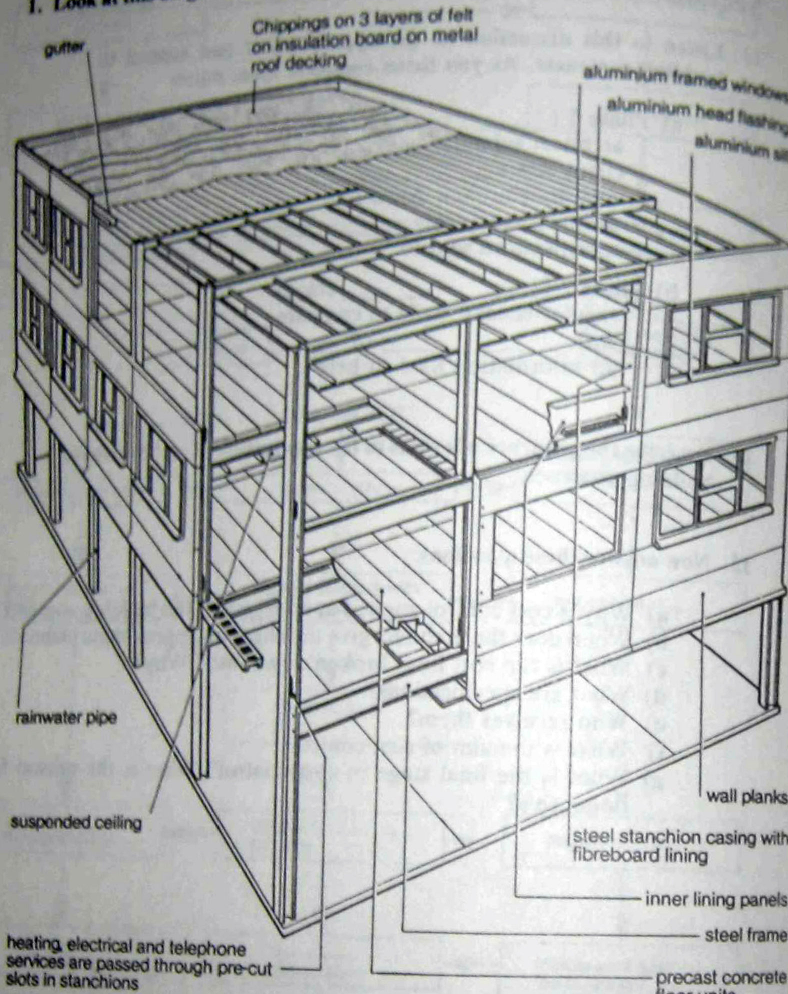
14. **Describe the sequence of events in the application of cost control to building contracts.**

15. **Now answer these questions:**

a) Why is cost control applied at all stages of the building contract?
b) When does the architect give the client an approximate estimate?
c) What is the cost limit broken down into? Why?
d) What are specifications?
e) Who receives them?
f) What is the aim of cost control?
g) What is the final stage in cost control? What is the reason for doing this?

Unit B Revision

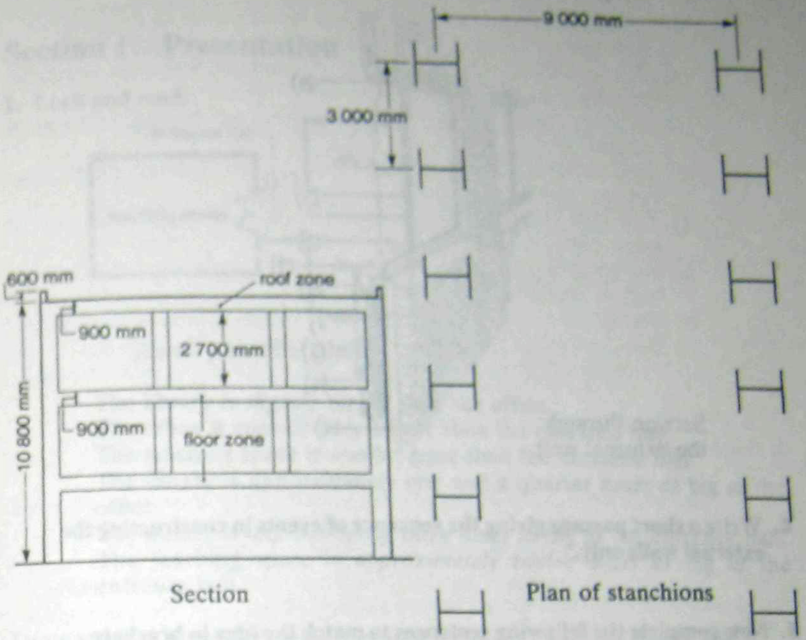
1. Look at this diagram of a prefabricated building:



Ask and answer questions like this:

Example: Why is the steel frame erected before the wall planks have been fixed?
Because the wall planks are supported by the steel frame.

2. Look at these drawings of the same building:



Section

Plan of stanchions

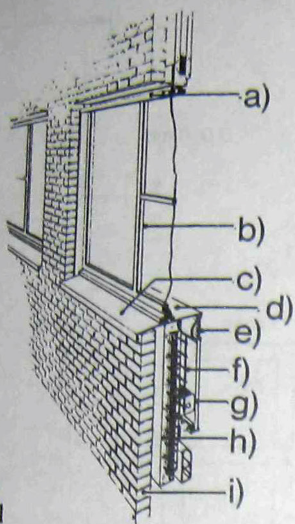
Make sentences saying what the dimensions marked on the drawings are:

Example: The floor to ceiling height is 2 700 mm.

3. Read this:

The external walls are made up of brick cladding, wall planks, windows, doors, heads and sills, stanchion casings and inner lining panels. While the steel frame is being erected, the wall planks and floor units are fixed. At the same time, the stanchions are enclosed in casings which serve the function of resisting fire. The precast concrete floor units are capable of carrying a load of up to 5 kN/sq m. The wall planks are designed to be weatherproof and to support the outer cladding. The aluminium heads, sills and windows are then fixed from inside the building. After this, the 900 mm and 1 800 mm wide external doors are installed. These doors are either aluminium framed and pre-glazed or hardwood framed and glazing is done on site. Finally, the internal sills and lining panels are installed. These form a cavity for the heating and electrical services. A grill underneath the sill, together with an air intake at skirting level, enables air to circulate up past the finned heating element. The lining panels are capable of being removed to give access to the services.

Now label this drawing:



Section through the external wall

4. Write a short passage giving the sequence of events in constructing the external walls only.

5. Now complete the following sentences to match the idea in brackets:

a) The external walls . . . . . . (structure)
b) The wall planks and floor units . . . . . . (time)
c) The stanchion casings . . . . . . (function)
d) The precast concrete floor units . . . . . . (ability)
e) The wall planks . . . . . . (function)
f) The external doors . . . . . . (measurement)
g) The glazing of the hardwood framed doors . . . . . . (location)
h) The internal sills and lining panels . . . . . . (function)
i) The grill . . . . . . (location)
j) The grill and air intake . . . . . . (function)
k) The lining panels . . . . . . (ability)

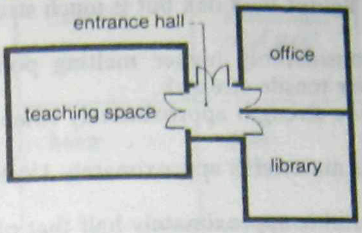
6. Answer these questions:

a) Why do you think the aluminium heads, sills and windows are designed to be fixed from *inside* the building?
b) What is the function of the fins on the heating element?
c) Are the aluminium framed windows glazed on site?
d) What are the advantages of using aluminium instead of steel to make the windows?
e) What other types of cladding could be used instead of brick?
f) What could this type of building be used for?

Unit 7 Measurement 2 Quantity

Section 1 Presentation

1. Look and read:



Sketch plan of a school

The library is *slightly* bigger than the office.
The office is *considerably* bigger than the entrance hall.
The teaching space is *much* bigger than the entrance hall.
The library is *approximately* one and a quarter *times as* big *as* the office.
The library is *approximately three times as* big *as* the entrance hall.
The teaching space is *approximately twelve times as* big *as* the entrance hall.

Draw a sketch plan of the rooms in your building. Label the spaces and compare their sizes.

2. Now look at this table:

	Density kg/m^3	Melting point 0° C	Typical tensile strength N/mm^2	Relative cost
Glass	2 520	1 500	60	12
Concrete	2 300	–	4	1
Softwood (pine)	5 500	–	40	6
Hardwood (oak)	8 800	–	100	15
Mild steel	7 850	1 900	450	9
Aluminium	2 640	660	90	35
Copper	8 950	1 083	340	25
Zinc	7 100	420	110	20

Identify these materials from the table:

a) This material has a slightly lower density than aluminium.
b) This material has a much higher melting point than glass.
c) This material has a tensile strength much higher than concrete, but slightly lower than zinc.
d) This material is slightly lighter than oak but is much stronger in tension.
e) This material has a considerably higher melting point than copper, but a much lower tensile strength.
f) This material has a tensile strength approximately twice that of pine.
g) The melting point of this material is approximately 1½ times as high as that of copper.
h) The density of this material is approximately half that of pine.
i) This material is ten times as strong as concrete in tension.
j) These two materials have very nearly the same tensile strength.

3. Look at these sentences:

The tensile strength of copper is approximately three times that of zinc.
Copper has a *much higher* tensile strength *than* zinc.

Now make similar sentences to compare the following:

a) Copper and aluminium with regard to their densities.
b) Zinc and oak with regard to their tensile strength.
c) Mild steel and aluminium with regard to their tensile strength.
d) Glass and concrete with regard to their densities.
e) Mild steel and copper with regard to their melting points.

4. Read this:

Oak is considerably heavier than pine, has a much higher tensile strength and costs 2½ times more per kilogramme.

Now compare the following in a similar way:

a) glass and concrete
b) aluminium and mild steel
c) copper and zinc
d) pine and mild steel

5. Look at this table:

Building component	Possible materials	Performance requirement
cladding	aluminium mild steel	a tensile strength of not less than 90 N/mm^2
beam	pine oak	a tensile strength of not less than 35 N/mm^2
roof covering	zinc copper	weight should not exceed 8 000 kg/m^3
fire door	mild steel copper	melting point should be in excess of 1 000° C

Use the above table together with the table in exercise 2, page 75, to make conversations like the following:

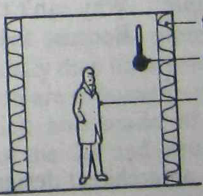
CLIENT: What do you think is the best material to use for the cladding?

ARCHITECT: Well, aluminium isn't really suitable. It's strong enough but it's too expensive. I think we should use mild steel. It's not only strong enough but it's also cheaper.

6. Make a list of the building materials found in your country. Compare these materials from the point of view of cost, strength and appearance.

Section 2 Development

7. Look and read:



Q1: Why is this person uncomfortable?

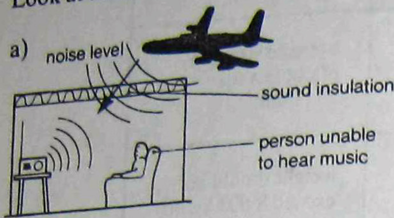
A: Because the temperature in the room is *too low*.
Because the room is *excessively cold*.

Q2: Why is the temperature *too low*?

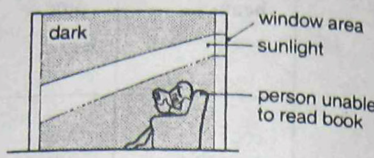
A: Because the thermal insulation is *inadequate*.
Because it has an *insufficient amount of* thermal insulation.
Because the thermal insulation is *not* thick *enough*.

Look at these drawings and make similar pairs of questions and answers:

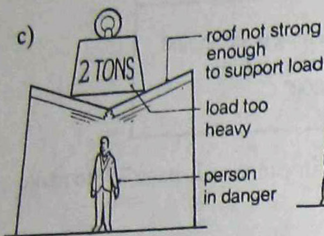
a)



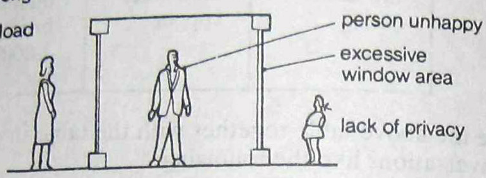
b)



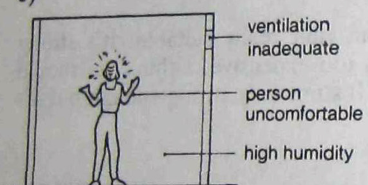
c)



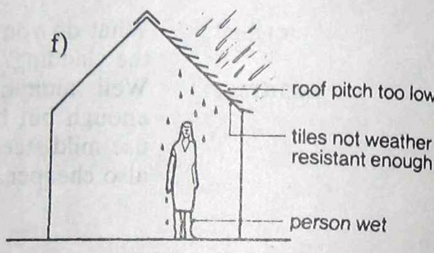
d)



e)



f)



8. Now ask and answer questions about anthropometric dimensions by looking at the diagrams of design situations in Unit 4, exercise 4, page 47:

Example: Why can't this man stand up straight?
Because the ceiling is too low.

9. Read this:

When an architect designs a house, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that there is adequate ventilation and at the same time he needs to ensure that the noise level is not excessive.

Now make similar statements using the following prompts:

a) (designs size of windows) adequate window area/sufficient privacy
b) (designs window area) sufficient warmth/adequate light
c) (designs thickness of sound insulation) cheap enough materials/ adequate sound insulation
d) (designs ventilation system) sufficient warmth/not excessive humidity
e) (designs roof) cheap enough materials/adequate weather proofing

Section 3 Reading

10. Read this:

Design of houses for tropical climates

The tropical regions of the earth can be divided into three major climatic zones:

1. *Warm-humid climates* are found in a belt near the Equator extending to about 15° north and south. There is very little seasonal variation throughout the year. The air temperature is never excessive, but there is considerable rainfall during most of the year. Relative humidity (RH) is excessively high – at about 75% for most of the time, but it may vary from 55% to almost 100% (RH should not exceed 70% for human comfort).

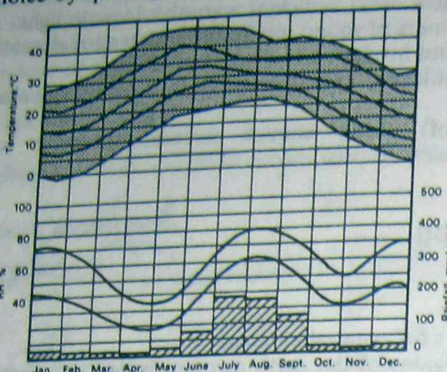
   In this climate the rooms of houses must have adequate shade and ventilation. Usually houses have an open layout so they can gain maximum benefit from the prevailing wind. Walls have less importance here than in other climates. They are used primarily for screening from insects and for their wind penetration qualities.

2. *Hot-dry climates* are found in two belts of latitude between approximately 15° and 30° north and south of the Equator. Two marked seasons occur: a hot and a slightly cooler period. Daytime air temperatures are excessively hot (normally higher than the 31°C to 34°C skin temperature), but at night it may fall as much as 35°C. During the day there is too little cloud cover to reduce the high intensity of direct solar radiation. However, at night the clear skies permit a considerable amount of heat to be reradiated to outer space.

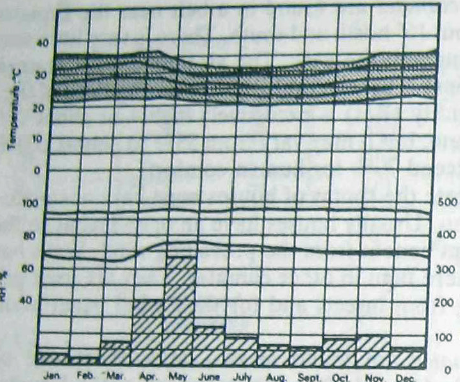
   In this climate houses must give adequate protection against the excessive heat of the sun. Usually they have compact layouts, so that surfaces exposed to the sun are reduced as much as possible. Walls should be very thick and made of heat storing materials so they hold the heat of the day and give it back to the interior of the house at night.

3. *Composite or monsoon climates* are found in large land masses near the tropics of Cancer and Capricorn. Two seasons occur normally. Approximately two-thirds of the year is hot-dry and the other third is warm-humid. Consequently, houses designed to be suitable for one season may be unsuitable for the other.

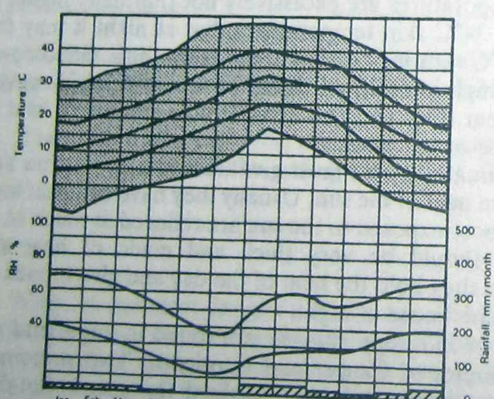
Now say which climate zone each of these graphs represent. Explain you choice by quoting from the text:



Climate A



Climate B



Climate C

Climatic zones in the tropics

11. The graphs show the climates for the following towns. Describe the location of the towns and their climates:

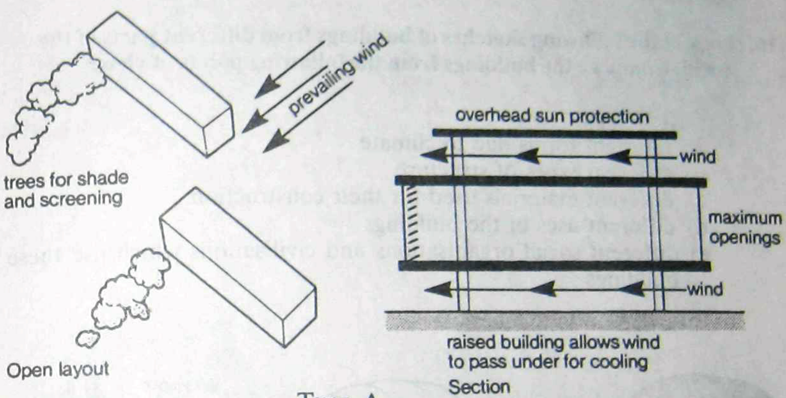
New Delhi Phoenix Mombasa

Now describe the location of your town and its climate.

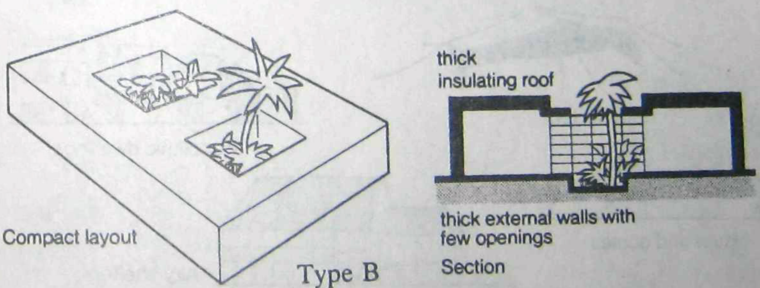
12. Make statements saying when and where an architect would have to take into account the following (which times of the year and for which places):

a) excessive humidity
b) insufficient rainfall
c) excessive rainfall
d) excessive heat

13. Look at these diagrams of two house types:



Type A



Type B

Say which is most suitable for a hot-dry climate and which is most suitable for a warm-humid climate. Then explain why using information from the reading passage and the diagrams.

14. Now complete this passage using these words:

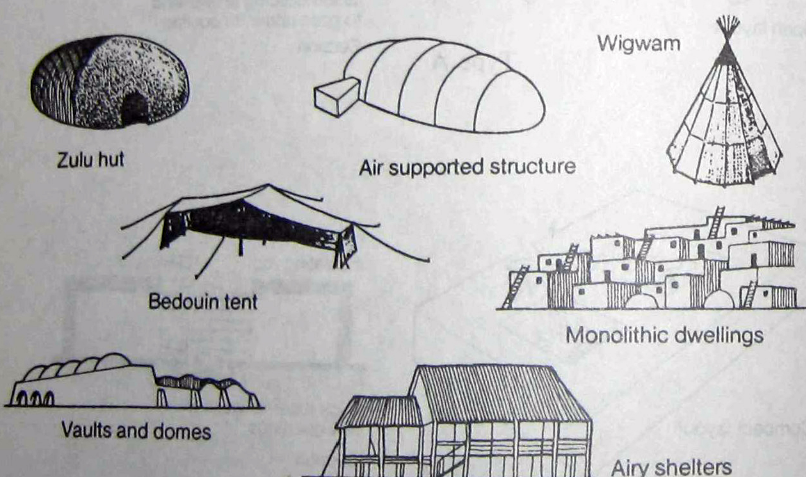
hottest, coolest, cool enough, warm enough, excessively, much lighter, inadequately, adequately

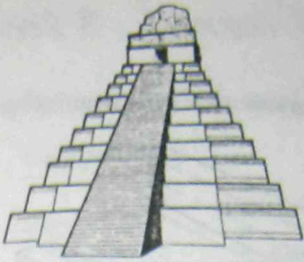
In composite climates, houses designed to perform ______ for one season will perform ______ for the other. To solve this problem houses are sometimes built two storeys high. The ground floor is built with ______ thick walls. These retain the heat so that it is ...... to sleep comfortably on the ground floor during the ______ part of the year. The first floor structure is built with ...... materials. This structure cools quickly at night so that it is ...... to sleep comfortably on the first floor during the ______ part of the year.

15. Draw a sketch section through a house suitable for a composite climate.

16. Look at the following sketches of buildings from different parts of the world. Compare the buildings from the following points of view:

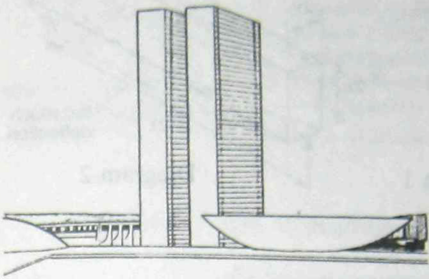
a) different forms due to climate
b) different types of structure
c) different materials used for their construction
d) different uses of the buildings
e) different social organisations and civilisations which use these buildings



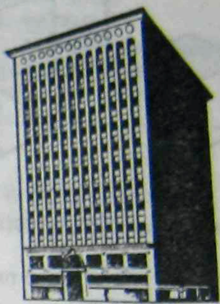


Temple 5, Tikal (after AD 700)

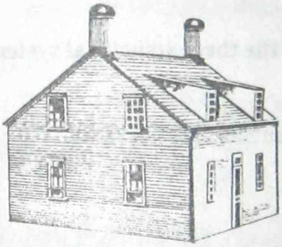
Temple of Aphaia, Aegina



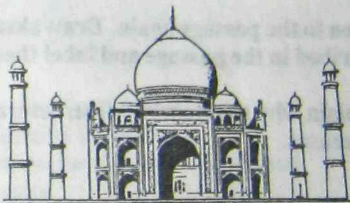
Palace of the National Congress, Brasilia



Guaranty Building, Buffalo

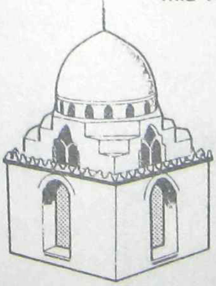


Typical house of Colonial America: mid 17th century

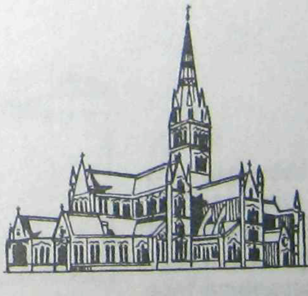


Taj Mahal, Agra

Temple of Heaven, Peking



Ibn Tulun Mosque, Cairo



Salisbury Cathedral, England

Section 4 Listening

17. Listen to the passage and look at these diagrams while you listen:

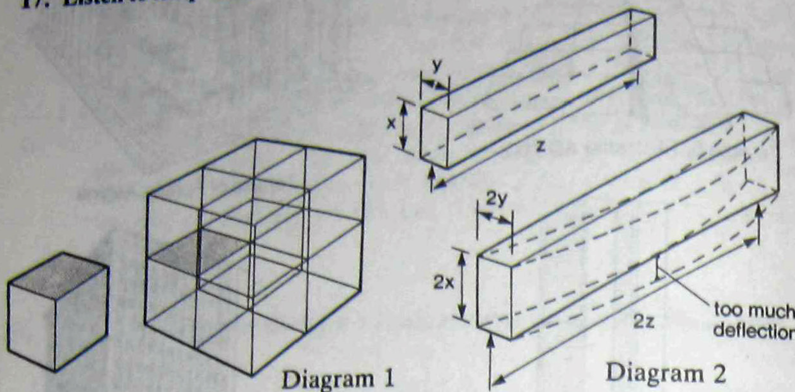


Diagram 1

Diagram 2

Now answer these questions:

a) What is the mathematical law that is very important in structural design?
b) Why are simple beams not economical over spans greater than six metres?
c) What structural system can be used when the economical length of girders is exceeded?

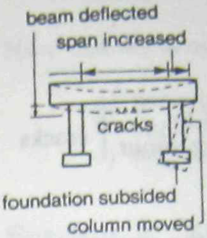
18. Listen to the passage again. Draw sketches of the three structural systems described in the passage and label them.

Now explain why the number of structural elements increases as the span increases.

Unit 8 Process 3 Cause and Effect

Section 1 Presentation

1. Look and read:

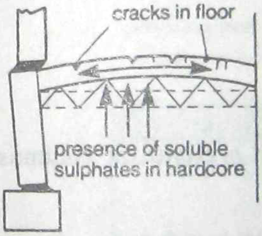


Cause	Effect
foundation subsided column moved span increased beam deflected excessively	column moved span increased beam deflected excessively cracks formed on the underside of beam

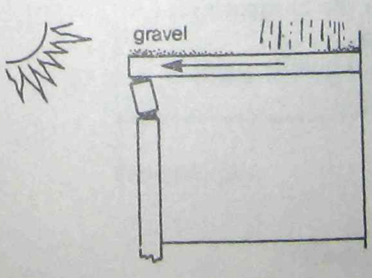
Example: The foundation subsided { *with the result that* / *and as a result* } the column moved.

Now make similar cause/effect statements from the table.

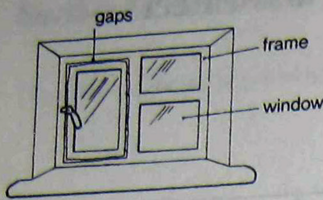
2. Look at these diagrams and put the events in the correct order to make cause/effect tables as in exercise 1:



a)
concrete floor expanded
cracks formed in floor
hardcore below the floor contained soluble salts
salts interacted with cement in concrete floor



b)
roof expanded
wall/roof joint failed
heavy rain washed away gravel on roof
roof heated up
roof inadequately protected from the sun



c)
gaps formed between window and frame
woodwork expanded
moisture content of wood increased
wood was painted with poor quality paint
later the wood dried and contracted

3. Read this:

Q: How did the subsidence of the foundation {*lead to* / *bring about*} cracks in the beam?

A: The subsidence of the foundation {*resulted in* / *caused*} the movement of the column. This, in turn, {*resulted in* / *caused*} an increase in the span of the beam, excessive deflection of the beam and the formation of cracks in the underside of the beam.

Now write answers to these questions:

a) How did the presence of soluble salts in the hardcore bring about cracks in the floor?
b) How did the washing away of the gravel by the rain bring about the failure of the wall/roof joint?
c) How did the poor quality paint bring about gaps between the window and the frame.

4. Read this:

Stabilising the ground under the foundations *prevents* the columns from moving.

Now complete these sentences:

a) Removing the soluble salts from the hardcore ......
b) Protecting the roof from the sun ......
c) Painting the woodwork with good quality paint ......

5. Look at the first diagram in Unit 7, exercise 7, page 77 and read this:

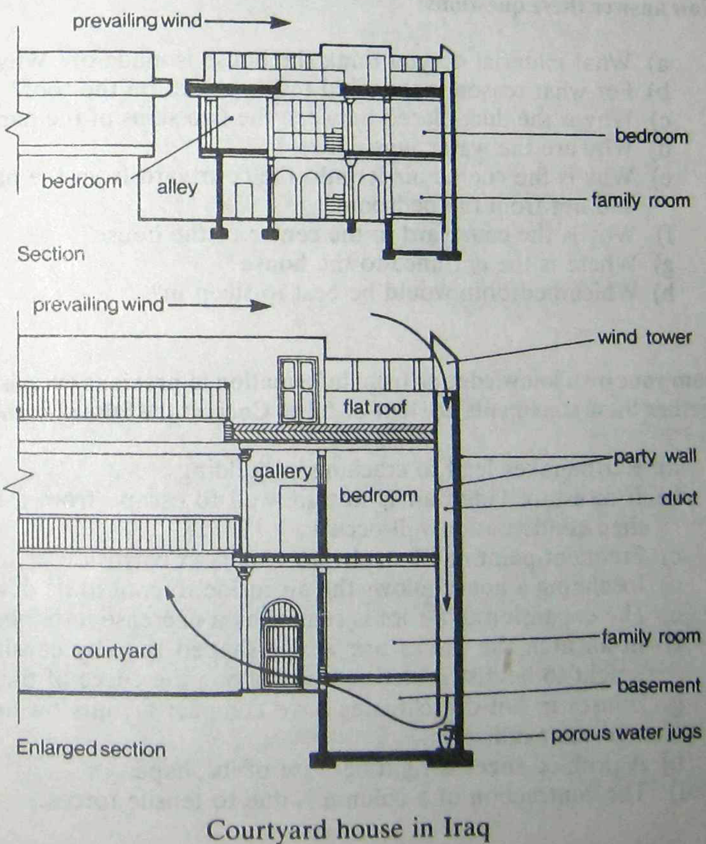
We have a problem with the air temperature in this room. It's too cold. This is { *because of* / *due to* } inadequate thermal insulation. You see, to a certain extent, the temperature in the room *depends on* the thickness of the insulation. *Consequently*, we should increase the thickness of the insulation.

Now look at the other diagrams and write similar paragraphs about these:

a) noise level
b) amount of light
c) degree of humidity

Section 2 Development

6. Look and read:



Courtyard house in Iraq

In some Iraqi houses a duct is contained between the two skins of a party wall. A wind tower is placed above the duct. This tower faces the prevailing wind with the result that it directs the wind through the duct into the basement of the house. The surfaces of the internal party wall remain at a lower temperature than the rest of the house throughout the day. This is because the wall is very thick and does not receive any direct solar radiation. The incoming air comes into contact with the surfaces of the duct and, as a result, is cooled by conduction. The relative humidity of the air is increased, just before it enters the basement, by passing it over porous water jugs. The air then leaves the basement through an outlet thereby helping to ventilate the courtyard during the daytime.

Find the cause or causes of these effects:

a) the wind is directed into the basement
b) the internal party wall is kept cool
c) the incoming air is cooled
d) the relative humidity of the air is increased
e) the courtyard is ventilated during the daytime

7. Now answer these questions:

a) What material do you think the house is made of? Why?
b) For what reason is the wind tower placed on the roof?
c) Why is the duct placed between the two skins of the party wall?
d) Why are the water jugs porous?
e) Why is the cooled air let into the courtyard from the basement and not from the bedroom?
f) Why is the courtyard in the centre of the house?
g) Where is the entrance to the house?
h) Which bedroom would be best to sleep in?

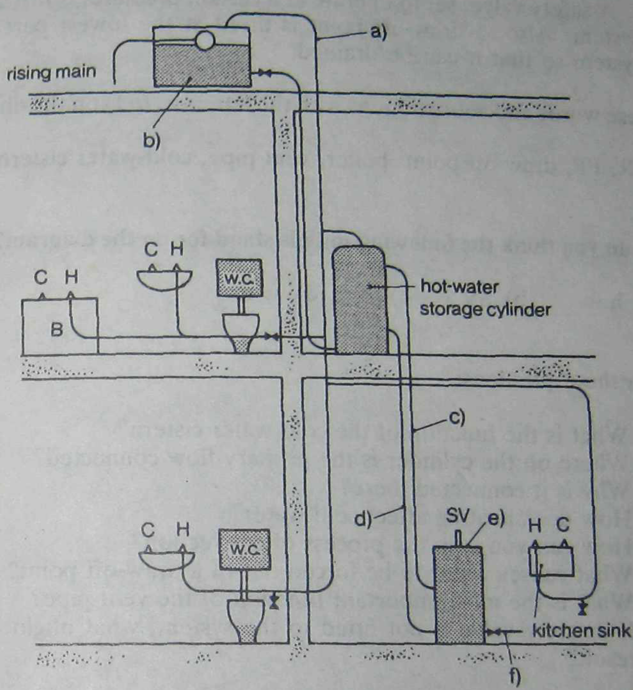
8. From your own knowledge or from information in previous exercises say whether these statements are true or false. Correct the false statements.

a) Earthquakes lead to cracking in buildings.
b) If moisture laden air is not allowed to escape from a building then condensation will occur.
c) Frequent painting of steelwork results in corrosion.
d) Insulating a house allows the air inside to cool to its dew point.
e) The expansion of a roof is caused by a decrease in temperature.
f) In an arch the bricks are wedge-shaped thereby causing their weight to be distributed upwards along the curve of the arch.
g) Houses in hot-dry climates have compact layouts owing to the high solar radiation.
h) A profiled sheet is rigid because of its shape.
i) The contraction of a column is due to tensile forces.

j) Condensation on the surface of a wall causes damp patches and stains and encourages mould growth.
k) Climate affects the form and orientation of buildings as well as the type of materials and construction methods used.

Section 3 Reading

9. Look and read:



A low-pressure hot-water system is shown in the diagram. Water in the boiler is heated, and consequently becomes less dense than the cold water in the higher parts of the system. The denser cold water sinks to displace the heated water, which is forced to rise. In this way, a circulation of water is set up – the process known as convection. The water rises up the primary flow (PF) into the hot-water storage cylinder, or tank, and is replaced by water descending the primary return (PR). If a temperature difference is maintained between the water in the primary flow and that in the primary return, then the process will continue. This is called the primary circulation and it is made more effective by connecting the primary flow to the upper region of both the boiler and the cylinder, and the primary return to the lower region of each. If a draw-off point is opened, water will be forced from it because of

the height of the water in the feed tank (often this tank is also the building's main cold-water storage cistern). The hot-water supply is drawn from the top of the storage cylinder, where it collects because its density is lower than that of the colder water.

Heating water causes the dissolved air contained in cold water to be released. Consequently, a vent pipe has to be taken from the top of the storage cylinder and carried up above the level of the water in the feed tank. The pipe allows air to escape from the system and, as a result, prevents the formation of air locks.

A safety valve, set to operate at a certain pressure, is fitted to the system. Also, a draw-off point is fitted at the lowest part of the system so that it can be drained.

Match these words and abbreviations with the letters a) to f) on the diagram:

PR, PF, draw-off point, boiler, vent pipe, cold-water cistern

10. What do you think the following initials stand for on the diagram?

a) h.w. b) SV c) B d) w.c.

11. Answer these questions:

a) What is the function of the cold-water cistern?
b) Where on the cylinder is the primary flow connected? Why is it connected there?
c) How does heating affect cold water?
d) How can you stop the process of convection?
e) What causes water to be forced out of a draw-off point?
f) What is the most important function of the vent pipe?
g) If a safety valve is not fitted to the system, what might be the result?

12. Complete these sentences which describe how the low-pressure hot-water system works:

a) Water in the boiler is heated with the result that ......
b) ...... is caused by the dense cold water sinking.
c) As a result of ...... water rises up the primary flow and is replaced by water descending the primary return.
d) ...... thereby continuing the process of convection.
e) The pressure at a draw-off point is due to ......
f) Hot water has a lower density than cold water. Consequently ......
g) The formation of air locks in the system is prevented by ......
h) The operation of the safety valve results in ......
i) ...... the system will drain.

Section 4 Listening

13. Look at the way these terms can be abbreviated:

structural failure : str flr
faults in design : flts in dsgn
reinforced concrete : r.c.

Now make your own abbreviations of these terms for use in exercise 14:

high alumina cement	collapse of beam
earthquakes	foundations
tensile strength	chemical reaction
strain on structure	roof support/wall
natural causes	

14. Now listen to the dialogue and use the abbreviations to complete these notes:

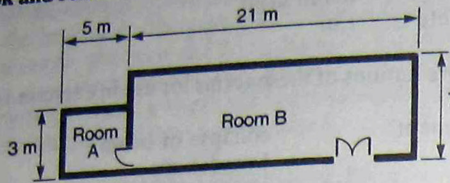
Causes of _______ _______
There are _______ types of cause:
1. ......
These may be due to mistakes by _______ or _______
e.g. a) ...... beams
cause: insufficient _______
result: ...... affected,
leading to ......
b) ......
cause: ......
which affects strength of ......
2. ......
e.g. a) _______
effect: (i) shake _______
(ii) causing stress and ......
leading to (iii) ......
b) Other causes include _______
and _______
c) In normal conditions, failure caused by ......
d) ......

15. Now use the notes to write two paragraphs on the causes of structural failure.

Unit 9 Measurement 3 Proportion

Section 1 Presentation

1. Look and read:

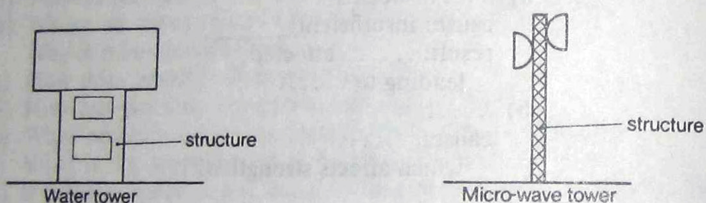


Plan of a building

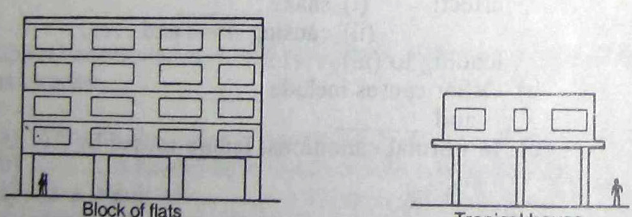
The *ratio between* the length *and* width of Room A is 5 : 3 (five to three).
The ratio between the length and width of Room B is 3 : 1 (three to one).
Room B is wider than Room A, but its width is less *in proportion* to its length.

Therefore Room B is { *relatively* narrow. / *proportionately* narrower.

Now look at these diagrams showing the relation between size and supporting strength:



Towers



Residential buildings

Answer these questions:

a) Which tower carries a relatively heavy load?
b) Which building carries a relatively light load?
c) Which part of the block of flats supports its weight?
d) Which part of the tower supports its weight?

e) What is the approximate ratio between the length of the columns of the block of flats and the height of the building?
f) What is the approximate ratio between the length of the columns of the tropical house and the height of the building?
g) Which building has longer columns in proportion to its size?
h) What is the approximate ratio between the length and thickness of the columns of the block of flats? (This ratio is called the slenderness ratio.)
i) What is the approximate ratio between the length and thickness of the columns of the tropical house?
j) Which building has proportionately thicker columns?

2. Make sentences from this table:

In comparison with Compared with	a	water tower, micro-wave tower, block of flats, tropical house,	a	water tower micro-wave tower block of flats tropical house

supports a relatively	heavy light	load and has	a –

proportionately	thicker thinner longer shorter	columns. tower structure.

3. Now read these two paragraphs and add the missing words:

a) If we *compare* the columns supporting the two buildings, we *can see* that the columns of the block of flats are *relatively* short and thick *in proportion* to its size, *while* those of the tropical house ...... We *can conclude* that the heavier building needs *proportionately* shorter and thicker columns, *whereas* ......

b) *The explanation for this is that* short thick columns are stronger than long thin ones *since* the strength of the column *depends on* its thickness and its length. Supporting strength is *directly* proportional to ______ and *inversely* proportional to ______. *Consequently, the heavier* the building, *the* ______ and ______ its columns, and *conversely*, the lighter the building ......

4. **Use the words in italics from exercise 3 to write two similar paragraphs comparing the two towers shown in exercise 1.**

Note: Substitute 'structure' for 'columns' and 'tower' for 'building', and make any other necessary changes.

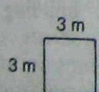
5. **Say whether these statements are true or false. Correct the false statements.**

a) The ratio between the height and width of the micro-wave tower is higher than that between the height and width of the water tower. (1 : 3 is a higher ratio than 1 : 2).
b) The structure of the water tower has to support less weight than that of the micro-wave tower.
c) The columns of the block of flats have greater supporting strength than those of the tropical house.
d) The strength of a column is directly proportional to its height and inversely proportional to its thickness.
e) Compare with a micro-wave tower, a water tower has a relatively tall structure.
f) The lighter the load on a tower, the thicker its structure.
g) Similarly, the heavier a building, the thinner its columns.

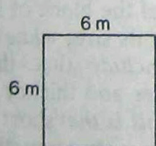
Section 2 Development

6. **Read this and follow the instructions:**

Perimeter in relation to size and shape
The ratio between the perimeter and floor area of a building has an important effect on the cost of the enclosing wall element. The perimeter/area ratio depends on the size and shape of the plan of the building.
To show how the perimeter varies with size:
Calculate the floor areas of the buildings illustrated below.
Calculate their perimeters.
Find the ratio between the perimeter and the floor area for each building.



Building A



Building B

a) Floor area =
b) Perimeter =
c) Perimeter/area ratio =

d) Floor area =
e) Perimeter =
f) Perimeter/area ratio =

Now complete these statements:

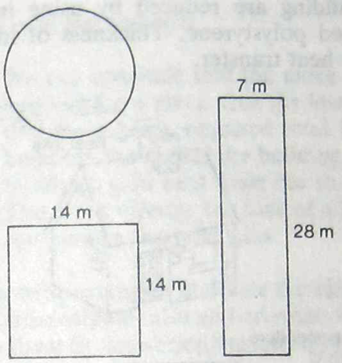
g) By comparing the ratio of perimeter to floor area for the two buildings we can see that the _______ building has a higher perimeter/area ratio.

h) We can conclude that smaller buildings have a _______ (longer or shorter) perimeter in proportion to floor area than larger buildings.

7. Now read and complete these:

To show how perimeter also varies with shape

a) These floor plans have the same area but they differ in shape. Do they have the same perimeter? Calculate the perimeters of the square and rectangular buildings.



	floor area	*perimeter*
circle	196 m^2	49·6 m
rectangle	196 m^2	......
square	196 m^2	......

b) The circular building, which has the most compact shape, has the smallest perimeter in proportion to area, whereas the ......, which has the least ...... has the _______ perimeter in proportion to area.

c) If we _______ the perimeters of buildings with the same floor area but different shapes, we will _______ that the more compact the shape ......

d) We can _______ that ...... ratio depends on _______ as well as _______.

8. Now use exercise 7 to help you show how surface area varies with shape. Calculate the surface areas of a sphere, a cube and a rectangular prism which all have the same volume.

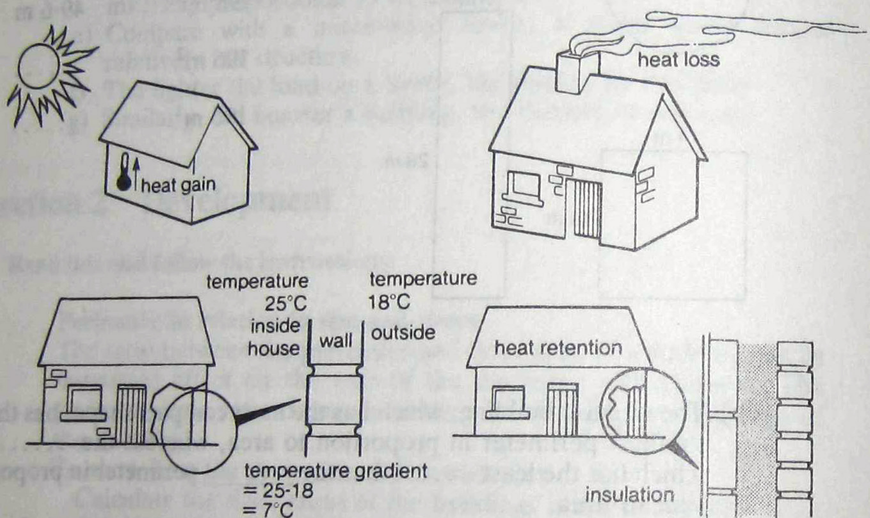
Section 3 Reading

9. Read this passage and look at the diagrams:

The effects of the surface area/volume ratio in architecture

The relation between surface area and volume has many effects on the performance of buildings. For example, the rate at which a building gains or loses heat through its walls depends on its surface area/volume ratio. Heat transfer is directly proportional to surface area and inversely proportional to volume. Thus a building with a proportionately large surface area, such as a one room house, will lose or gain heat relatively rapidly. Conversely, a building with a large volume in relation to its surface area, such as a block of flats, will retain more heat.

Heat losses from a building are reduced by using insulating materials such as expanded polystyrene. Thickness of insulation is in inverse proportion to heat transfer.



Make true statements from these tables:

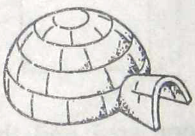
Heat transfer Heat loss Heat gain Heat retention	is	directly inversely	proportional to	air temperature gradient. thickness of insulation. surface area. volume.

The higher the ratio between surface area and volume,	the more quickly it gains or loses heat.
The lower the ratio between surface area and volume,	the more it retains heat.
The smaller the size of the building,	the faster the rate of heat transfer.
The larger the size of the building,	the less it retains heat.
The thicker the insulation of a building,	the more slowly it gains or loses heat.
The more compact the shape of a building,	the slower the rate of heat transfer.
The less compact the shape of a building,	

10. Now read this passage:

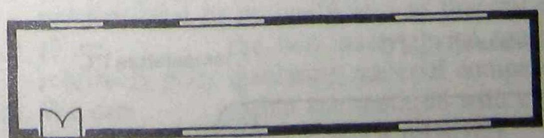
> We can conclude that the more compact the shape of the plan of a building for a given area the less the heat loss. It can also be shown that for a given required total floor area in a two or more storey building, the higher the building the greater the heat loss. However, buildings gain heat from the sun as well as losing heat to the cold. The more directly the face of a building is at right angles to the sun the greater the heat gain.

The following examples illustrate the effects of the perimeter/area ratio, the surface area/volume ratio and orientation of the building on heat transfer. Explain them by answering the questions:

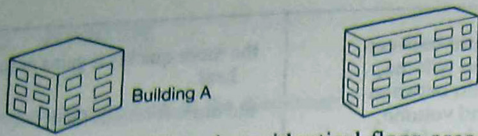


a) Igloos are built by Eskimos in the Arctic where the cold is very intense. Why do they build them this shape?

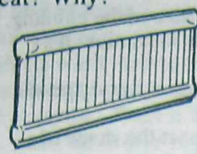
b) Mud houses are built by people in the tropics where the heat is very intense. Why do they build the walls so thick?



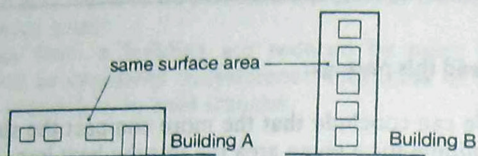
c) Why are some houses in tropical climates built with plans shaped like this?



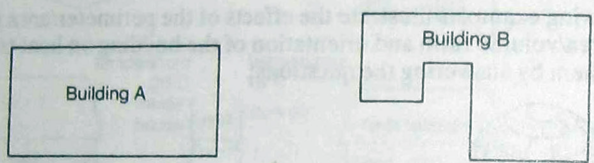
d) These two buildings have identical floor areas. Which of them loses the greater amount of heat? Why?



e) Why do radiators have fins?



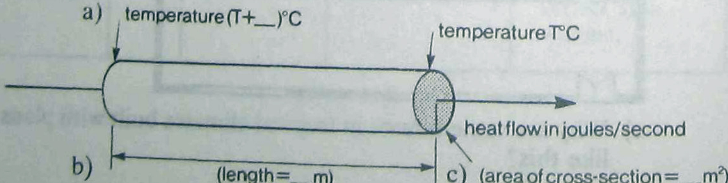
f) Which of these two south-facing elevations will receive the greater amount of solar radiation. Why? Will the solar radiation be greater in summer or winter?



g) Both these buildings have the same floor area and the same height. Which one will be more expensive to heat?

Section 4 Listening

11. Listen to the passage. Copy and complete the diagram, the notes and the table:



d) k = $\dfrac{\ldots\ldots}{\ldots\ldots \times \ldots\ldots}$

The units of k are

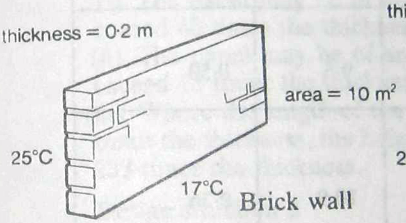
e) $\dfrac{\ldots\ldots}{\_\_\_\_\_\_ \times \_\_\_\_\_\_ \times \ldots\ldots}$

that is
f) ......
or
g) ......

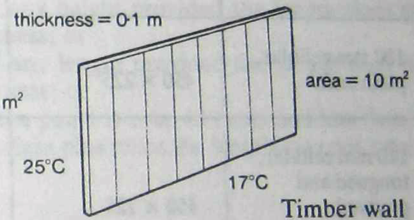
h)

Material	k value
copper	380
______	______
______	______
______	______
______	______
______	______

12. Calculate the number of joules of heat flowing through these two walls during one hour:



Brick wall



Timber wall

Now complete the statements:

a) The ratio between the rates of flow of heat through the two walls is ......

b) The brick wall has a ______ thermal conductivity than the timber wall.

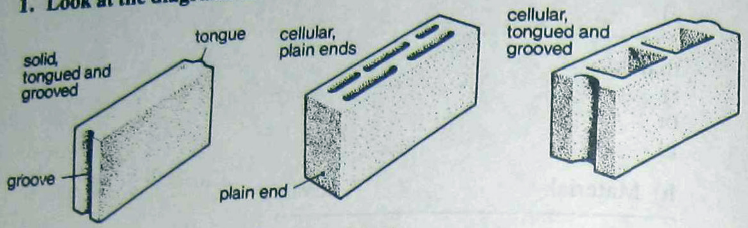
c) The rate of flow of heat through a material is ______ proportional to its coefficient of thermal conductivity.

d) If we ______ the two materials we can see that ______ is a relatively poor insulating material compared with ______.

e) We can ______ that the material with a ______ coefficient of thermal conductivity needs a relatively ______ wall to achieve the same degree of insulation.

Unit C Revision

1. Look at the diagrams and the table:



Concrete blocks

Thickness and type of block	Dimensions of face (length × width)	Block weight	Thermal resistance (r)
	in mm	in kg	m^2 °C/w
75 mm solid, tongued and grooved	400 × 200	6·3	0·26
100 mm cellular, plain ends	450 × 225	9·5	0·50
140 mm cellular, tongued and grooved	450 × 225	10·9	0·36

Now answer these questions:

a) What is the ratio of the length to width to thickness of each block?
b) Which block is proportionately thickest?
c) Compare the three blocks with regard to their thickness, width, weight and thermal resistance.
d) What do you think is the function of the tongue and groove?
e) Why do you think the two largest blocks have a cellular structure?
f) What do you think are the advantages of concrete blocks over bricks with regard to cost, speed of building and the amount of mortar used?

2. Read this:

Stability of concrete block walls

Block walls should be designed so that they have stability against overturning. Walls may be divided into a series of panels and stability provided by connecting the edges of the panels to supports which are capable of transmitting the lateral forces to the structure. The length or height of the panel in relation to the thickness of the wall has to be limited. The limits for three different design situations are described below and may not be exceeded.

From the text complete the following sentences to match the idea in brackets:

a) Block walls ...... (ability)
b) The height of the panel ...... (proportion)
c) The edges of the panels ...... (structure)
d) The panel supports ...... (ability)

And this sentence from your own experience:

e) If a wall is too thin ...... (cause and effect)

3. Continue reading:

Design situation 1

Walls with adequate lateral restraint at both ends but not at the top

(i) The panel may be of any height provided the length does not exceed 40 times the thickness; or

(ii) The panel may be of any length provided the height does not exceed 15 times the thickness; or

(iii) Where the length of the panel is over 40 times and less than 59 times the thickness, the height plus twice the length may not exceed 133 times the thickness.

Design situation 2

Walls with adequate lateral restraint at both ends and at the top

(i) The panel may be of any height provided the length does not exceed 40 times the thickness; or

(ii) The panel may be of any length provided the height does not exceed 30 times the thickness; or

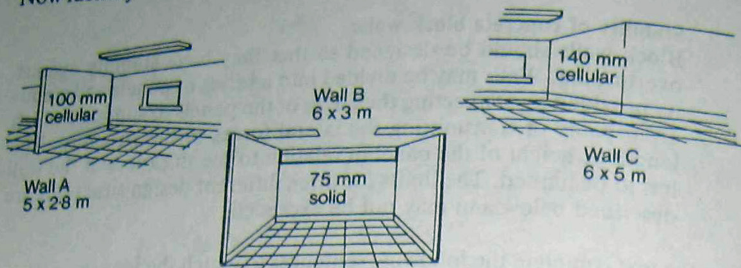
(iii) Where the length of the panel is over 40 times and less than 110 times the thickness, the length plus three times the height should not exceed 200 times the thickness.

Design situation 3

Walls with adequate lateral restraint at the top but not at the ends

The panel may be of any length provided the height does not exceed 30 times the thickness.

Now identify the three design situations in the drawings:



Wall A | Wall B | Wall C

Work out if any of the walls are unstable because their design limits have been exceeded and make sentences like this:

Example: The 75 mm solid block wall is { *stable* / *unstable* } because its length { *does not exceed* / *exceeds* } 40 times its thickness.

4. Read this:

The thermal resistance of a material and the thickness of that material used in a roof determine the loss of heat through a roof. Poor insulants have high k-values whereas good insulants have very low k-values. Increasing the thickness of the insulation laid on a roof will increase its resistance to heat loss in direct proportion. Thus the thermal resistance (r) of each element of the roof structure is directly proportional to its thickness (x) and inversely proportional to the thermal conductivity (k) of the material, i.e.

$$r = \frac{x}{k}$$

If the resistance of all the elements of the roof structure are added, this gives the total or overall thermal resistance (R).

$$R = r_1 + r_2 + r_3 + r_4 + \ldots\ldots$$

where r_1 is the resistance of the waterproof membrane, etc.
The overall thermal conductance of the whole roof structure (U) is the reciprocal of the overall thermal resistance (R), i.e.

$$U = 1 \div R$$

The U-value is a measure of the overall rate of heat loss through the total roof structure. A well insulated roof has a low U-value. The higher the U-value, the greater the heat loss through the roof. U-value is defined as the heat loss (w) per unit roof area (m) per degree celsius temperature difference (°C) between the warm interior of the building and the cold exterior.

Now complete this paragraph about thermal resistance using these words:

high, higher, low, lower, greater

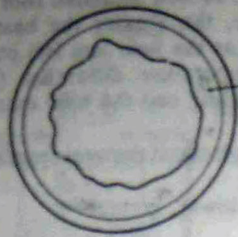
The _______ the U-value of a roof, the _______ the R-value and the _______ the loss of heat through the roof. A well insulated roof has a _______ thermal resistance and a _______ U-value.

5. Look at this table:

Element of roof structure	Material	Thickness (x)	k-value (w/m °C)
Waterproof membrane	3-layer bitumen felt copper sheet	0·01 m 0·002 m	0·18 380
Insulation board	polyurethane foam cellular glass	0·025 m 0·025 m	0·023 0·046
Vapour barrier	felt	–	–
Roof deck	concrete slab wood-wool slabs	0·15 m 0·05 m	1·40 0·10
Internal lining	dense plaster ceiling plasterboard	0·016 m 0·013 m	0·50 0·16

Now design two roofs each with five elements and using all the materials in the table. Calculate the total thickness and the U-value for each roof.

6. Look and read:



Section through a pipe

One disadvantage of the direct hot-water system described in Unit 8, exercise 9 is that it is liable to 'scaling'. Scaling is caused by deposits made by hard water when it is heated. Hard water occurs in areas which have soluble salts in the ground. Because the highest temperatures in the system occur in the boiler, the largest amounts of scale are deposited there. Since the deposited material is a bad conductor, heat is prevented from passing through the walls to the water and the efficiency of the boiler is reduced. This can lead to further trouble because the boiler walls may overheat, and in some cases the plates may even burn out, causing leaks. Because of this, boilers often have removable plates so that the inside can be de-scaled.

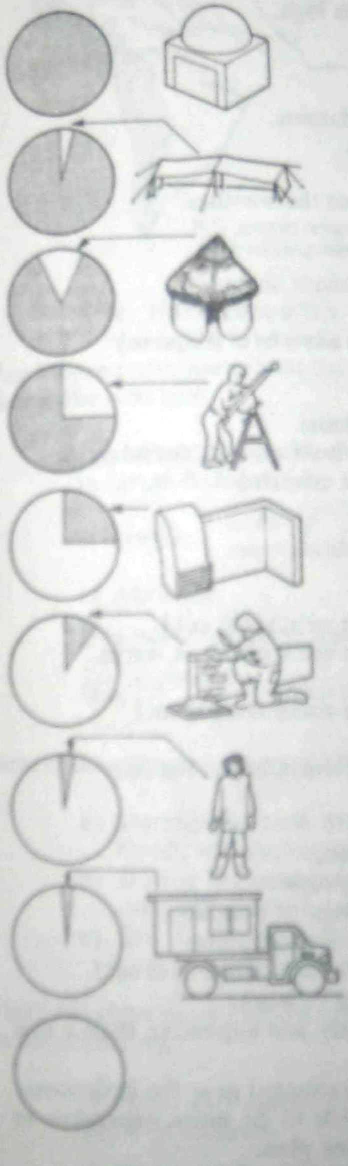
Now make statements about:

a) The effect of soluble salts in the ground.
b) The cause of scaling.
c) Which factor determines the amount of scaling.
d) A property of scale.
e) Four possible effects resulting from a property of scale.
f) The function of removable plates in boilers.

Unit 10 Measurement 4 Frequency, Tendency, Probability

Section 1 Presentation

1. Look and read:



All buildings enclose space.

Buildings {*always* / *invariably*} enclose space.

Nearly all people live in houses.
People *nearly always* live in houses.

Most buildings have windows.

Buildings {*usually* / *generally*} have windows.

Many architects work in a design team.

Architects {*often* / *frequently*} work in a design team.

Some buildings have air-conditioning.
Buildings *sometimes* have air-conditioning.

A few people build their own houses.
People *occasionally* build their own houses.

Few people live in very cold climates.

People {*rarely* / *seldom*} live in very cold climates.

Very few buildings are portable.

Buildings are *very* {*rarely* / *seldom*} portable.

No building lasts forever.
Buildings *never* last forever.

Now complete these statements by starting with one of the following:

all nearly all most many some a few few very few no

a) Architects have studied architecture at university.
b) Buildings have entrances on the ground floor.
c) Bridges are built of concrete.
d) Buildings have doors.
e) People live in cities.
f) Blocks of flats are over 50 metres high.
g) Architects are self-employed.
h) Houses are prefabricated.
i) Shops are accessible by car.
j) Buildings are built on rock foundations.
k) People are taller than 1·8 metres.
l) Factories have solid walls.
m) Buildings are designed to keep out the weather.
n) Hotels are completely fireproof.
o) Buildings are two dimensional.

2. Now rewrite the above statements using the adverbs of frequency introduced in exercise 1:

Examples: Buildings *usually* have doors.
Buildings are *sometimes* built on rock foundations.
(Note the position of the adverb.)

3. Look at these statements:

People *tend to need* heating when the weather is cold.
People *tend not to need* heating when the weather is warm.

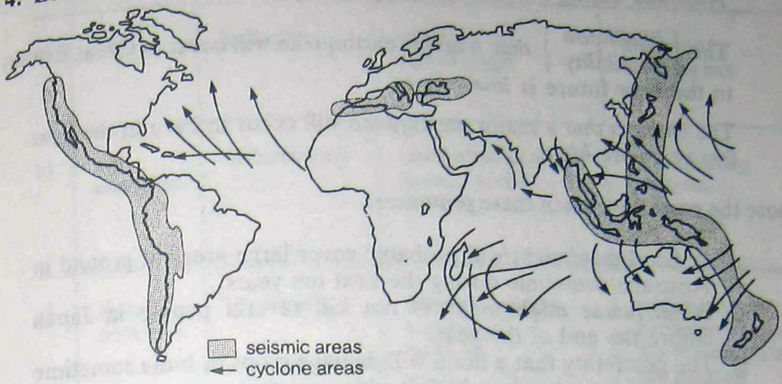
i.e. This is usually true, but there are some *exceptions*.

Now say whether these statements are true or false. Correct the false statements.

a) People tend to walk in straight lines.
b) People tend to come together in groups.
c) Climate tends not to affect the design of buildings.
d) People tend to sit in the sun when it is very hot.
e) People open the windows in their houses when it is cold.
f) People tend to live near their place of work.
g) A tall building tends to be relatively less expensive than a low building.
h) In a house, the kitchen tends to be situated near the bedrooms.
i) A building with a simple plan tends to be more expensive to build than a building with a complex plan.

Section 2 Development

4. Look and read:



Seismic areas and cyclone zones

Note: Hurricanes often tend to cause serious flooding.

Read these statements about the possibility of a catastrophe occurring during the next year:

It is almost impossible that an earthquake *will* cause serious damage in Great Britain.

It is highly { *unlikely* / *improbable* } *that* an earthquake will cause serious damage in Australia.

It is *possible that* an earthquake will cause serious damage in Italy.

It is { *probable* / *likely* } *that* an earthquake will cause serious damage in Japan.

Now choose the correct words in these sentences:

a) During the next year it is possible/improbable/probable that floods will destroy several houses in Great Britain.
b) During the next year it is likely/unlikely/impossible that a hurricane will destroy a city in Peru.
c) During the next ten years it is highly improbable/likely/unlikely that an earthquake will kill several people in California.

Here are some more expressions used to talk about the possibility of an event occurring:

A major earthquake *might* occur in Australia during the next year, but it is unlikely.

A major earthquake *may* occur in Italy soon.

A major earthquake *will probably* occur in Japan during the next six months.

There is a very slight possibility that a major earthquake will occur in Australia during the next twelve months.

The $\left\{\begin{array}{l}\textit{likelihood}\\ \textit{possibility}\end{array}\right\}$ *that* a major earthquake will occur in Great Britain in the near future is *low*.

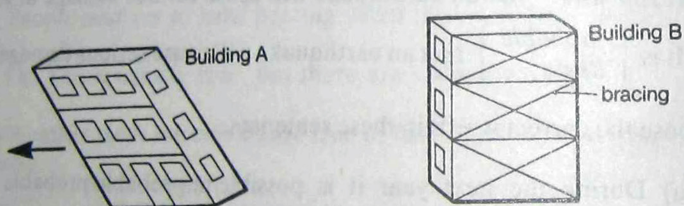
The *chances that* a major earthquake will occur in Peru in the next five years are *high*.

Choose the correct words in these sentences:

d) A flood may/might/will probably cover large areas of ground in Australia sometime during the next ten years.
e) A hurricane might/may/will not kill several people in Japan before the end of the year.
f) The possibility that a flood will damage crops in India sometime during the next year is high/low/non-existent.
g) There is no/a slight/a strong possibility that a hurricane will destroy several buildings in Peru sometime during the next ten years.
h) The likelihood of an earthquake causing a breakdown in power supplies in Florida is low/non-existent/high.

5. Discuss the possibility of catastrophes occurring in your country and their likely effects.

6. Look and read:



Houses in Japan after an earthquake

Architects looking at buildings in Japan after an earthquake, observe that Building A has collapsed because the structural frame was not braced to resist the force of the earthquake. From this observation we can make the following generalisation:

Buildings $\left\{\begin{array}{l}\textit{tend to}\\ \textit{are likely to}\end{array}\right\}$ collapse during an earthquake if their structural frames are not braced to resist the force of earthquakes.

7. Look at this table about other hazards:

	Country	Hazard	Possible effect	Precautions taken
a)	Iran	hailstorm	penetrate the roof of a light structure	make roof covering hail resistant
b)	All countries	thunderstorm	cause structural damage to tall buildings	fit a lightning conductor
c)	Hot-dry countries	sandstorm	damage exterior surfaces of a building	stop by erecting barrier screens a few metres from the building
d)	Africa	attack by termites	destroy the wooden components of a building	treat wood with preservatives
e)	All countries	fire	cause structural damage to buildings	use fireproof materials

(i) What observations do you think you could make about buildings in the above countries?

Example: During a hailstorm in Iran, the roof of a light structure was penetrated because the roof covering had not been made hail resistant.

(ii) What generalisations can you make?

Example: Roofs of light structures in Iran are likely to be penetrated during a hailstorm if they are not hail resistant.

Section 3 Reading

8. Read this:

The gravitational force on a structure can be divided into dead loads and live loads. Dead loads can be calculated accurately because they rarely change with time and are usually fixed in one place. Live loads are always variable and movable, so no exact figures can be calculated for these forces.

Structures must also resist other types of forces, such as wind or earthquakes, which are extremely variable. It is impossible to predict accurately the magnitude of all the forces that act on a structure during its life; we can only predict from past experience the probable magnitude and frequency of the loads.

Engineers never design a structure so that the applied loads exactly equal the strength of the structure. This condition is too dangerous because we can never know the exact value of either the applied loads or the strength of the structure. Therefore, a number called a 'factor of safety' is used. The safety factor is defined as the ratio of the probable strength of the structure and the probable loads on the structure. This factor may range from 1·1 (where there is little uncertainty) to perhaps 5 or 10 (where there is great uncertainty).

Now answer these questions:

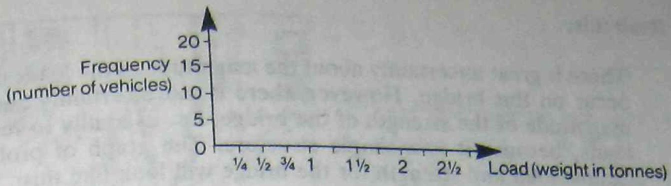
a) Can the loads from the internal partitions of a building be estimated accurately? Why?
b) Can the loads from storage in a building be estimated accurately? Why not?
c) How can an engineer predict the possible loads that will occur on a structure?
d) Why do engineers never design a structure so that the applied loads exactly equal the strength of the structure?
e) When there is great uncertainty about the loads on a structure and the strength of a structure, does an engineer choose a high or low safety factor?
f) When does failure occur?

9. Read this:

A survey was made of the weights of 74 vehicles passing over a bridge. The results of the survey were recorded as follows:

Weight in tonnes	Number of vehicles
0 to ¼	1
¼ to ½	3
½ to ¾	7
¾ to 1	15
1 to 1¼	20
1¼ to 1½	13
1½ to 1¾	8
1¾ to 2	4
2 to 2¼	2
2¼ to 2½	1

Copy the diagram at the top of page 111 and use the results to make a bar chart.



Now complete these sentences predicting average future loads from vehicles on the bridge:

a) It is _______ that the load will be less than 0 tonnes.
b) The _______ that the load will be 0·3 tonnes is _______.
c) It is _______ that the load will exceed 2 tonnes.
d) The most frequent load on the bridge will probably be between _______ and _______ tonnes.

10. Now read this:

74 identical structural components were tested for tensile strength. The results were as follows:

Tensile strength at failure in tonnes	Number of components
1¼ to 1½	4
1½ to 1¾	18
1¾ to 2	30
2 to 2¼	18
2¼ to 2½	4

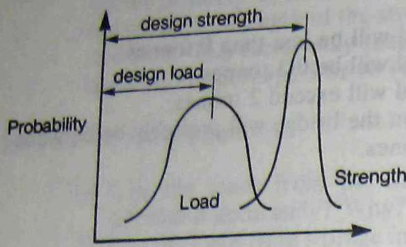
Copy the diagram in exercise 9 again and use these results to make another bar chart.

Now say whether these statements are true or false. Correct the false statements.

a) Most of the components failed at a load between 1½ and 1¾ tonnes.
b) No components failed below a load of 1¼ tonnes.
c) Nearly all the components failed above a load of 1½ tonnes.
d) Very few components failed over a load of 2½ tonnes.
e) If these components are used in a bridge which is loaded to destruction, they will probably fail at a load between 2 and 2¼ tonnes.

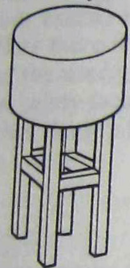
11. Read this:

There is great uncertainty about the magnitude of the loads that will occur on this bridge. However, there is more certainty about the magnitude of the strength of the bridge, i.e. its ability to resist the loads, because it is a simple structure. The graph of probability against load and strength for the bridge will look like this:

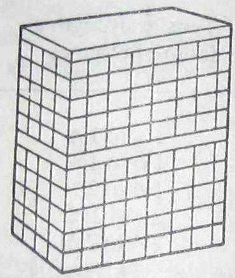


$$\text{safety factor} = \frac{\text{design load}}{\text{design strength}}$$

Now match these two graphs with these two design situations. Say when there is great certainty or uncertainty about loads or strength:

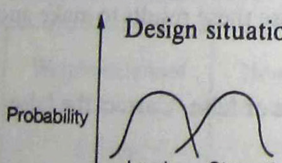


Water tower in Great Britain



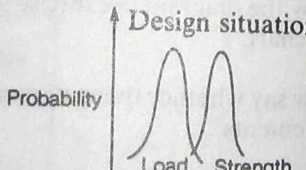
Multi-storey building in Japan

Design situation 1



Graph A

Design situation 2



Graph B

In which situation will the safety factor be 2 and in which 6?

Section 4 Listening

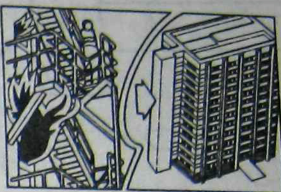
12. Look at the pairs of drawings on page 113 and discuss them:

Each pair of drawings shows a design mistake which could be dangerous, and a way of reducing the danger.

1

2

3



4

5

6

7

13. Now listen to the passage and list the numbers of the diagrams in the order you hear them described.

14. Listen to the passage again and for each pair of diagrams take notes on:

a) the design mistake
b) the possible event resulting from the mistake
c) the action needed to correct the design mistake

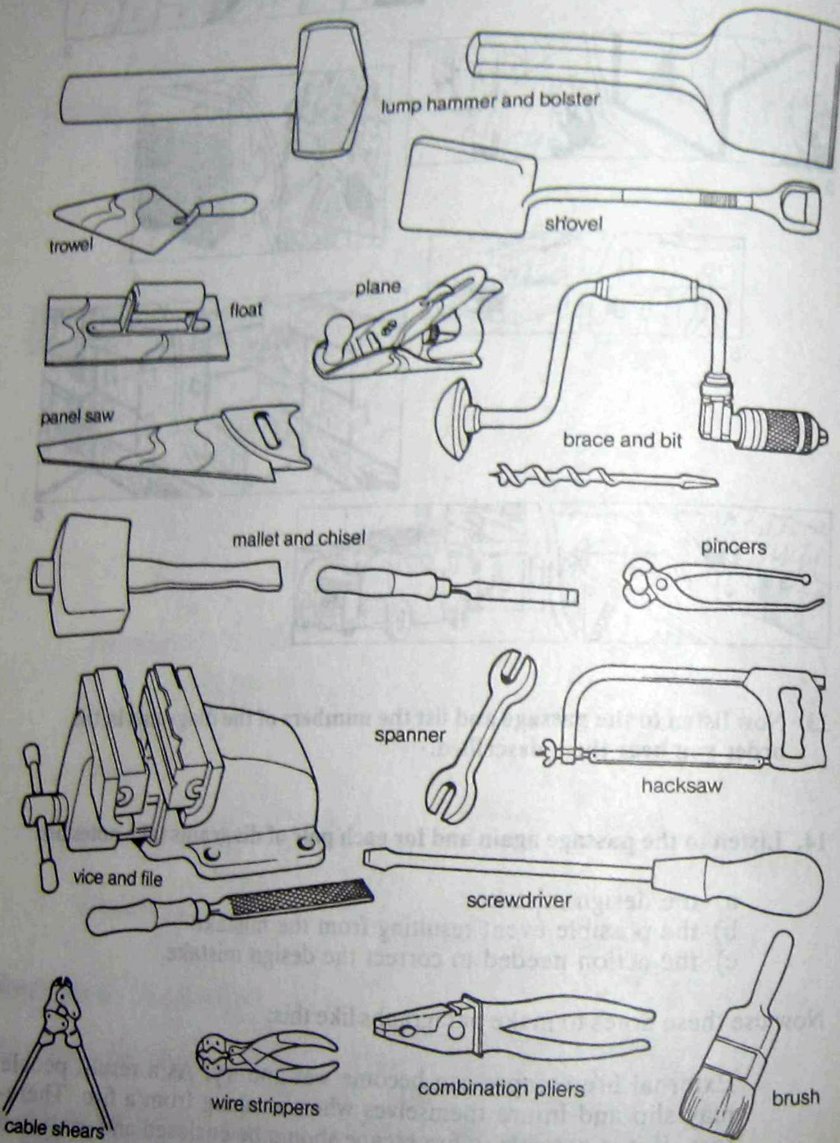
Now use these notes to make paragraphs like this:

> External fire escapes can become wet and icy. As a result, people may slip and injure themselves when escaping from a fire. Therefore, if it is possible, a fire escape should be enclosed and protected from the weather.

Unit 11 Process 4 Method

Section 1 Presentation

1. Look at these diagrams of the tools used by tradesmen working on a building site:



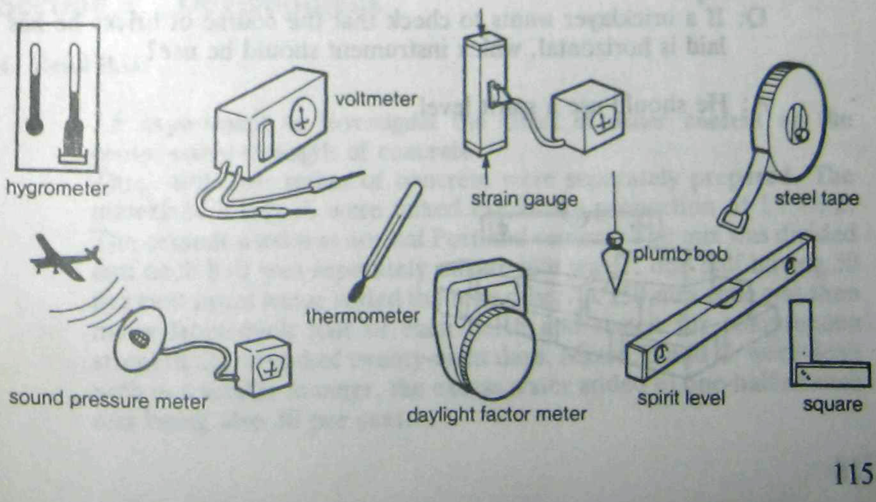
Now copy and complete the table with the correct tools or combination of tools for the jobs:

Tradesman	Job	Tool (s)
a) Carpenter	drilling holes in wood	
b) Bricklayer	mixing mortar	
c) Plasterer	smoothing the plaster on a wall	
d) Carpenter	cutting wood	
e) Plumber	cutting metal pipes	
f) Electrician	cutting electric cables	
g) Carpenter	making a mortise-and-tenon joint	
h) Plumber	smoothing metal surfaces	
i) Electrician	removing the outer sheathing of wire	
j) Carpenter	turning screws	
k) Decorator	painting surfaces	
l) Bricklayer	cutting bricks	
m) Plumber	tightening nuts	
n) Electrician	twisting strands of wire together	
o) Carpenter	smoothing wood surfaces	
p) Bricklayer	laying mortar on bricks	
q) Carpenter	removing nails	

Now make sentences like the example:

A brace and bit is a tool for drilling holes in wood.

2. Look at these drawings of instruments:



Now make sentences from this table:

A An	lighting engineer structural engineer bricklayer acoustic engineer heating and ventilating engineer carpenter electrician	uses	a square a plumb-bob a hygrometer a strain gauge a voltmeter a sound pressure meter a daylight factor meter a thermometer a spirit level a steel tape

to	check verticality. measure the illumination from the sky. measure the sound pressure. measure the relative humidity. check vertical and horizontal work. measure the temperature. measure the voltage of a circuit. check squareness. measure distances. measure the strain on a structure.

Use the table again to make sentences like the following:

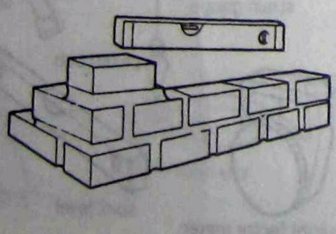
Verticality $\left\{ \begin{array}{l} \textit{may} \\ \textit{can} \end{array} \right\}$ be checked $\left\{ \begin{array}{l} \textit{by means of} \\ \textit{by using} \\ \textit{with} \end{array} \right\}$ a plumb-bob.

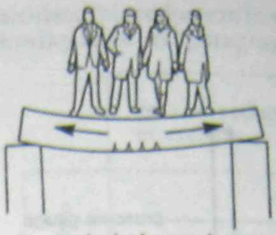
3. Ask and answer questions like the example with the help of the diagrams:

Example:

Q: If a bricklayer wants to check that the course of bricks he has laid is horizontal, which instrument should he use?

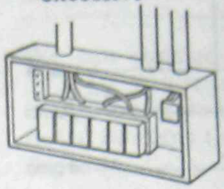
A: He should use a spirit level.



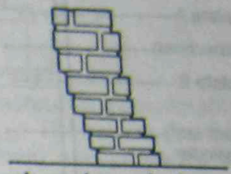


a) strain in beam is not excessive

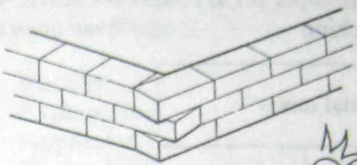
b) reduction in noise due to sound insulation



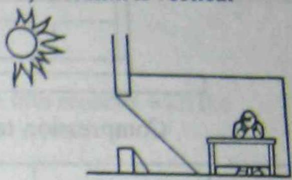
c) power circuit is working properly



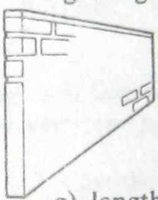
d) column is vertical



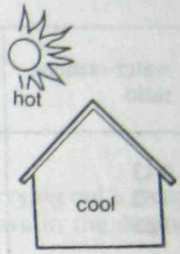
e) two walls are at right angles



f) daylight on a working surface



g) length of wall



h) moisture content in the air

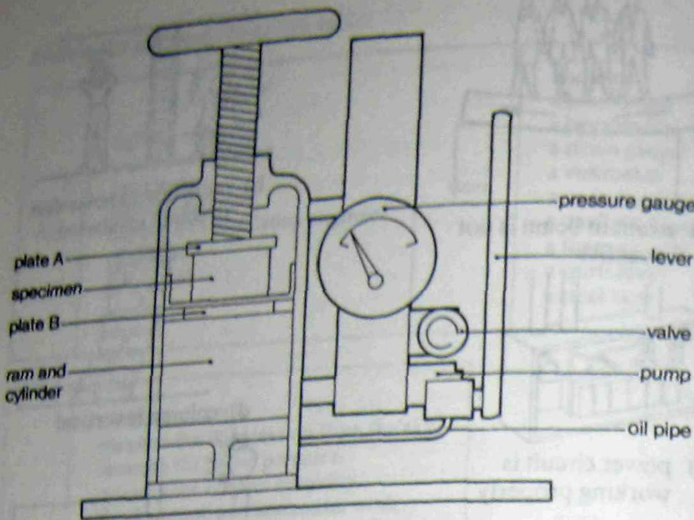
i) temperature difference between inside and outside

Section 2 Development

4. Read this:

An experiment to investigate the effect of water content on the compressive strength of concrete

Three different mixes of concrete were separately prepared. The materials in mix A were mixed dry in the proportion of 1 : 1 : 2. The cement used was normal Portland cement. The mix was divided and each half was separately mixed with water, one half having 30 per cent more water added than the other. A 150 mm cube was then made from each half of each batch and tested for compression strength at the end of twenty-eight days. Mixes B and C were dealt with in a similar manner, the excess water added to one-half of each mix being also 30 per cent.



Compression testing machine

Mix	Proportions of cement, sand and aggregate	Normal mixes	
		water-cement ratio	strength N/mm^2
A	1 : 1 : 2	0·43	34·9
B	1 : 2 : 4	0·62	20·3
C	1 : 3 : 6	0·85	10·7

Mixes with 30 per cent excess water	
water-cement ratio	strength
0·56	23·4
0·81	11·6
1·10	5·9

From these results we can calculate the per cent reduction in strength for the three mixes due to the excess water.

Now calculate this reduction in strength for mixes B and C, and complete the following table and paragraph:

	per cent reduction in strength
A	33
B	
C	

We can conclude that the _______ of concrete is considerably _______ as a result of the additional _______. The reason for this is that water combines chemically with cement and an excess of water weakens this reaction on which the strength of the concrete depends.

5. Now divide the report of the experiment above into sections with the following headings:

Results
Explanation
Apparatus
Conclusion
Procedure
Purpose

6. Read these instructions for carrying out a compression test on a concrete cube using the apparatus shown in the diagram in exercise 4:

a) Cast the concrete mix in a steel mould of 150 mm by 150 mm by 150 mm internal dimensions and store in a damp cabinet for 24 hours.
b) Remove the specimen from the mould and immerse in water until the cube is ready for testing.
c) Place the concrete specimen on the lower compression plate.
d) Lower the upper compression plate on to the top of the specimen.
e) Raise and lower the lever to operate the hydraulic ram moving plate B upwards.
f) Continue this pumping action until the specimen is crushed.
g) Note the reading on the pressure gauge.

Now look at these results of compression tests done on concrete specimens made of three different types of cement and performed at different intervals of time:

Type of cement	Nominal mix	Compressive strength (N/mm^2)				
		3 days	7 days	28 days	3 months	1 year
Ordinary Portland	1 : 2 : 4	9·65	17·2	26·8	33	45
Rapid-hardening		17·2	24·1	34·4	38	48·2
High alumina		48·2	49	55	No appreciable increase	

Write a report of the experiment with the following headings:

Purpose
Description of apparatus
Procedure
Results
Conclusion

7. The experiment above measured the compressive strength of concrete. Discuss methods of measuring these properties:

a) tensile strength of steel
b) hardness of copper
c) combustibility of plastic
d) permeability of brick

Section 3 Reading

8. Look and read:

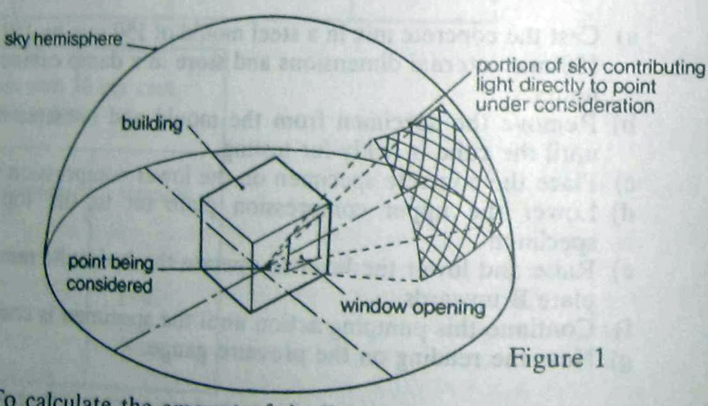


Figure 1

To calculate the amount of daylight in a room, first calculate the direct light from the sky, and secondly, calculate the indirect light which consists of the reflected light from external surfaces and light received by reflection from the internal surfaces of the room. The total of direct and indirect light gives the total daylight. This is

usually expressed as the daylight factor in the room, that is, the ratio of the light in the room to the light of the unobstructed sky.

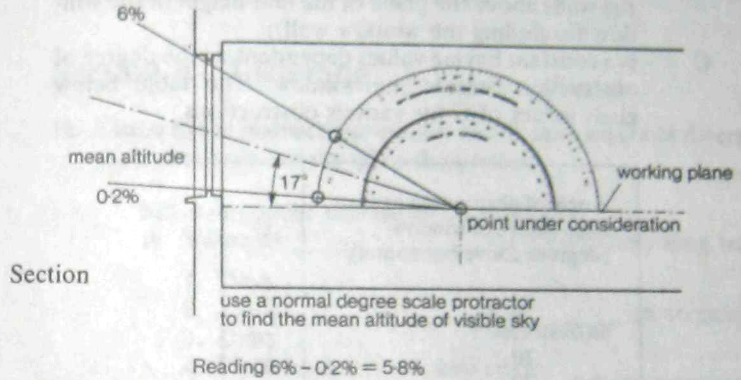
Direct daylight

The direct light from the sky which reaches any given point in a room is determined by how big a patch of sky can be seen from that point (Figure 1), or, more strictly, the projected solid angle subtended by the patch of visible sky at that point. It is also determined by the brightness of the patch of sky. If the brightness of the patch of sky can be assumed to be uniform, the ratio of direct internal light to the external light from the sky is known as the sky component, and it is proportional to this projected solid angle.

Formulae have been worked out to enable the sky component to be calculated.

A simpler method of determining the direct light from the sky is by means of sky component protractors which can be laid directly on to the working drawings. Figure 2 shows the use of the protractors.

An alternative method is to use published tables.



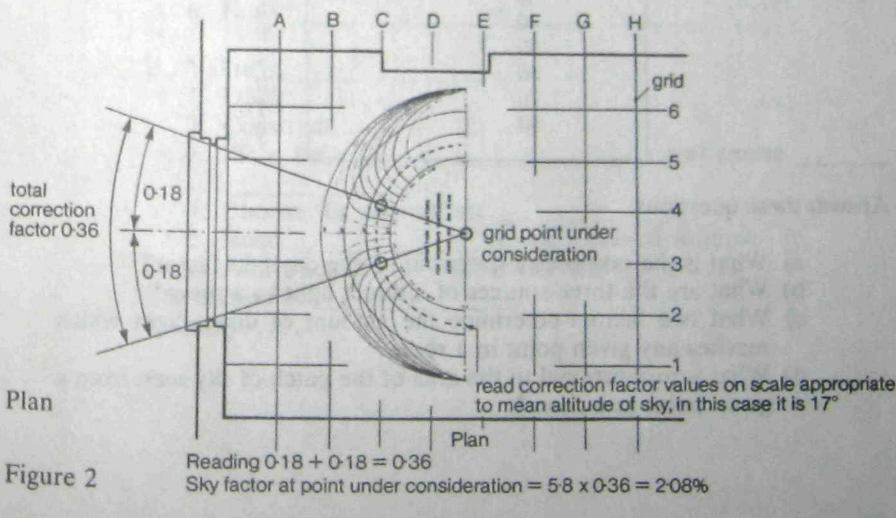


Figure 2

Indirect daylight

The indirect component can be obtained from special graphs called nomograms or more simply (but less accurately) from published tables.

The indirect light in a room can also be calculated by using the formula:

Average level of indirect light in room expressed as a percentage of external light from whole sky $= \dfrac{0{\cdot}85S}{A(1-R)} \quad (CR_{fw} + 5R_{cw})\%$

where S = area of window (actual glazed area);
A = total area of ceiling, floor and walls;
R = average reflectance of ceiling, floor and all walls, expressed as a fraction;
R_{fw} = average reflectance of the floor and those parts of the walls below the plane of the mid-height of the window (excluding the window wall);
R_{cw} = average reflectance of the ceiling and those parts of the walls above the plane of the mid-height of the window (excluding the window wall);
C is a constant having values dependent on the degree of obstruction outside the window. The table below gives values of C for various obstructions.

Angle of obstruction as seen from centre of window (degrees above horizontal)	C
no obstruction	39
10	35
20	31
30	25
40	20
50	14
60	10
70	7
80	5

Answer these questions:

a) What is the purpose of determining the daylight factor?
b) What are the three sources of indirect light in a room?
c) What two factors determine the amount of direct light which reaches any given point in a room?
d) What is proportional to the area of the patch of sky seen from a given point in a room?

e) How can the sky component be determined at the design stage?
f) What is the advantage of using the protractor to calculate the sky component?
g) Is the indirect component directly proportional to the area of the internal surfaces of the room?
h) If another building obstructs incoming light, is the indirect component increased or decreased?

9. Read this:

One method of calculating the sky component is by using formulae. *Alternatively*, a simpler method may be used whereby the ratio is calculated by means of protractors.
Another method of calculating the sky component is by referring to published tables.

Now write three similar sentences about the methods used to calculate the indirect component of the daylight factor.

Section 4 Listening

10. Listen to the instructions on how to use protractors to determine the sky component and complete these notes:

Sky component consists of two values:
A. Value of _______ _______ for an infinitely long window

1. Draw ......
2. Mark _______ _______ and _______ on section.
3. Draw ......
4. Place base ...... and centre _______ _______ _______ .
5. Read off _______ .
6. Note _______ _______ of _______ _______ .

B. Value of _______ _______
1. Draw ......
2. Construct ......
3. Place base _______ _______ _______ and centre _______ _______ _______ .
4. Choose the appropriate _______ _______ .
5. Read _______ _______ for each side of window.
6. Add where ...... otherwise subtract ......

Calculation of _______ _______ .
Multiply ......

11. Rewrite the instructions in a similar way to the following, using linking phrases to join the instructions together:

Example: { *First of all,* / *Then,* / *(etc.)* } a section of the room perpendicular to the window *should be drawn.*

12. Draw this:

Draw a plan of a room and then draw a one metre square grid on it. Calculate the daylight factor for each grid point. For this exercise use sky component protractors. You can make them by tracing the protractors illustrated in Figure 2, exercise 8 and sticking the diagrams on card.

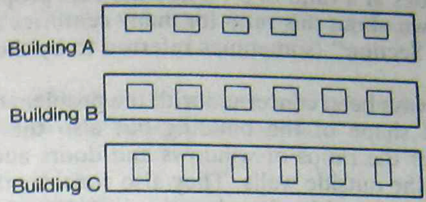
13. Now say if the daylight factor of any point in the room is below the minimum standard by referring to this table:

Minimum daylight standards	
Room	Daylight factor (measured on working plane)
kitchen	2 per cent
living room	1 per cent
bedroom	0·5 per cent
classrooms	2 per cent
offices	1 per cent

Note: Minimum design standards are based on an illumination of 5 000 lux from the whole unobstructed sky.

Unit 12 Consolidation

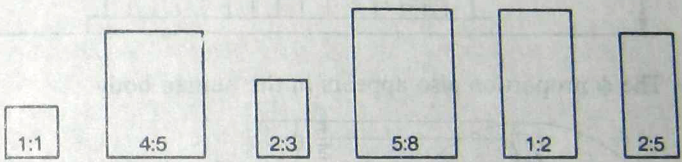
1. Look at these elevations of three buildings:



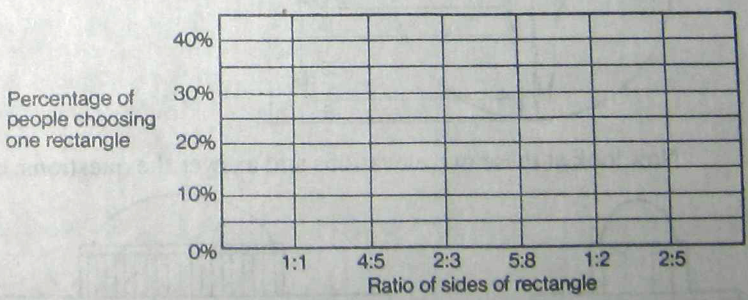
Now read this:

> The windows of each building have a different ratio of long side to short side, i.e. their proportions are different. Architects also talk about a building having good proportions. By this they mean that certain definite ratios between dimensions and sizes are more pleasant than others.
>
> Discuss which elevation you find most pleasing to look at.

Now look at these rectangles and say which shape in your opinion has the best proportions:



Now copy the graph and complete it from a survey of the opinions of at least 30 people:

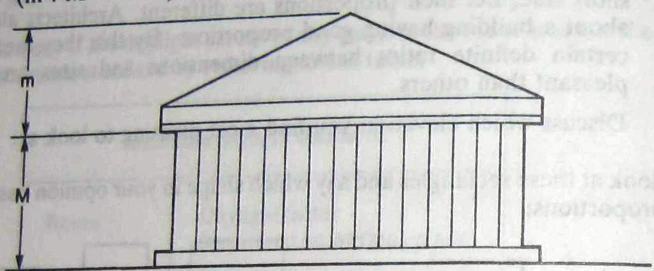


> Discuss whether the results show that a majority of people find the proportions of one rectangle more pleasing than the others.

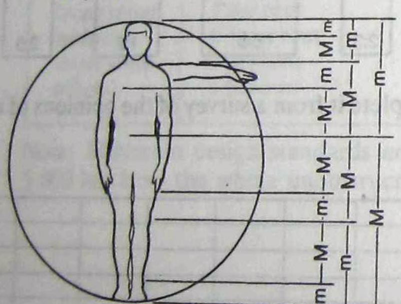
2. Read this:

In an experiment, a great number of people were shown the rectangles you looked at in exercise 1. About 35 per cent thought that the rectangle with sides at a ratio of 5 : 8 had the best proportions. Architects have known about this ratio for many centuries and it is called "The Golden Section" (sometimes referred to by the Greek symbol ϕ).

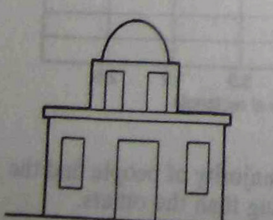
Architects have always been concerned with the problem of ratio, not only the overall shape of the building but also the smaller shapes. They consider the ratios of windows and doors and relate them to the ratios of the outside walls. They also consider the ratio of the height, length and width of each room in relation to each other. A building, then, can be seen as a complicated system of ratios. In order to design a building which people felt had a pleasing appearance, architects often related their measurements to ϕ (m : M = 5 : 8).



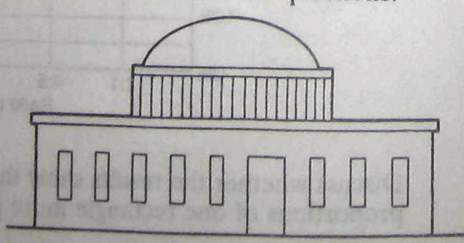
The ϕ proportion also appears in the human body:



Now look at these two elevations and answer the questions:



Elevation A

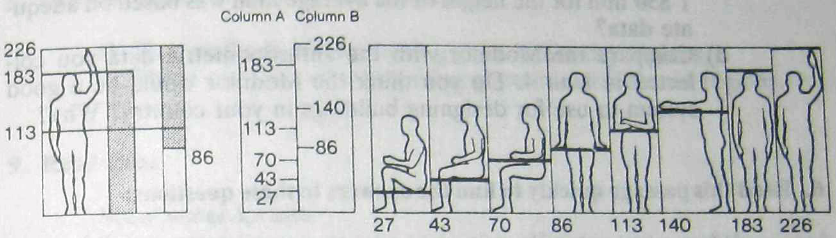


Elevation B

a) What ratios have been used to design Elevation A and Elevation B? (Describe the ratios used for the overall shape, doors and windows.)
b) Has one ratio been used to which all the other ratios are related? If so, what is it?
c) Which elevation do you think has the most pleasant appearance?

3. **Draw the plan and elevations of a real building and try to discover what ratios have been used to design it.**

4. **Look and read:**



Le Corbusier devised a system of proportions and measurements which he called the Modulor. This consists of two sets of figures. The first is based on the height of the average man which he assumed to be 1 830 mm. If this height is divided according to the Golden Section, the longer of the two parts will be 1 130 mm which corresponds to the navel height. This height can again be divided according to the Golden Section, when the figure 700 mm will be obtained for the longer part. We can go on dividing and subdividing according to ϕ until a whole range of figures is found. This is column A in the diagram. Column B is obtained in the same way, but in this case the starting point is the height of the average man with his arm stretched up (2 260 mm). This dimension is divided again and again as in the case of column A. Dimensions can be obtained from the Modulor that give heights for chairs, low benches, counters and other dimensions.

Say whether these statements are true or false. Correct the false statements.

a) Le Corbusier invented the Modulor.
b) The dimensions of column B are based on the height of the average man.
c) The dimensions are divided according to the ratio 5 : 8.

d) The maximum measurement used in the Modulor is 2 250 mm and the minimum 160 mm.
e) According to the Modulor the height of a chair seat should be 430 mm.

5. Redesign the building you drew in exercise 3 using the Golden Section. Relate all the proportions of the building to this ratio.

Now answer these questions:

a) Does the building now have a more pleasing appearance?
b) What advantages do you think there are in designing a building using the Modulor?
c) Does the text in exercise 4 say whether Le Corbusier's choice of 1 830 mm for the height of the average man was based on adequate data?
d) Compare the Modulor with the anthropometric data you collected in Unit 4. Do you think the Modulor would be a good system to use for designing buildings in your country? Why?

6. Read this passage quickly to find the answers to these questions:

What causes glare in
a) hot-dry regions?
b) warm-humid regions?

One of the problems in hot climates is to exclude not only radiant heat but also glare, while at the same time admitting sufficient daylight. There is a fundamental difference between the problem in the arid and humid regions. In the arid regions, glare is caused by sunlight being reflected from the surface of the ground and light coloured walls of other buildings. A traditional way of overcoming this problem is by keeping windows on the external elevations small and few in number, with the larger, low level windows overlooking the shaded internal courtyard. Too sharp a contrast between a bright opening and the surrounding inside wall surface results in glare. For this reason, when small windows are used on the external walls, they must be designed with care. One traditional method of overcoming this problem is to use vertical slit windows which are usually located in the corners of rooms. Another method is to locate the windows between the ceiling and eye level, or alternatively filters can be used in the form of lattices, screens or shutters.

High humidity and typically overcast conditions in the warm-humid regions result in a high proportion of the radiation being diffused so that the sky is the main source of glare. Because large openings are needed for cross ventilation, low overhanging eaves or

wide verandahs are used to obstruct the view of most of the sky. In traditional houses thin external walls of coarsely woven mats, which in some cases can be rolled up, allow full advantage to be taken of every breeze.

7. Now choose a title for the paragraph:

Give reasons for your choice by saying which of the titles is too general, too specific, or not sufficiently accurate.

The difference between arid and humid regions
Glare and daylight
Methods of overcoming glare from the sky
Problem of admitting sufficient daylight

8. Draw diagrams to illustrate the following:

a) Five methods of overcoming glare in hot-dry regions.
b) Three methods of overcoming glare in warm-humid regions.

9. Read this:

Solar water heaters

Solar water heaters consist of a solar collector and a well-insulated tank. The function of the collector is to absorb solar radiation during the day and transfer heat to the water. The tank serves to store the water with little temperature loss until it is required. Various types of absorber units are found, but the relatively simple flat-plate collector is most commonly used. The collector normally consists of the following components: an absorber or heat-exchanger element, insulation, cover and absorber box.

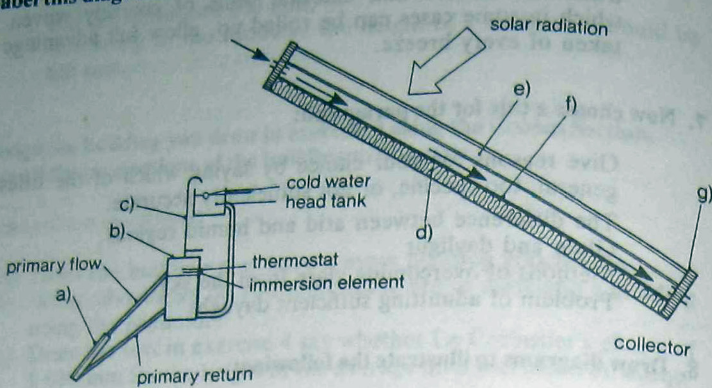
Now read the following descriptions of the components of a collector and name them:

a) A thick layer of material with a low U-value placed behind the unexposed side of the collector plate.
b) A weatherproof container made of wood, metal, or plastic.
c) Two flat sheets of transparent glass or plastic.
d) A sheet of flat material constructed so that channels are formed through which water can circulate. It is painted black.

Now match these functions with the components of the collector:

e) To prevent rain from affecting the insulation and to provide a support for the transparent cover.
f) To absorb the maximum amount of radiation and to prevent the minimum amount of radiation being re-radiated.
g) To reduce heat losses to the rear to a minimum.
h) To reduce convection and low-temperature radiation heat losses from the absorber surface.

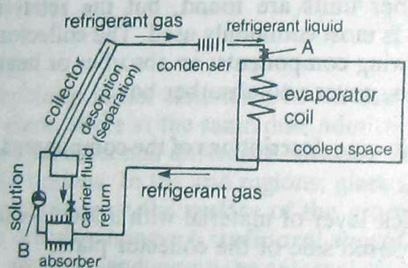
10. Label this diagram:



Solar water heater

11. Read this:

Space cooling can be achieved by use of the heat obtained from the sun directly, to drive an absorption refrigerator. This is essentially the same machine as the domestic gas or paraffin (kerosene) operated refrigerator.



Put these sentences in the correct order to make a paragraph describing the principles of operation of an absorption refrigerator:

a) Heating by solar radiation (or any other means) will expel some of the refrigerant from the solution.
b) The warmed refrigerant gas is re-absorbed in the carrier fluid.
c) It operates on the following principles:
d) The liquid refrigerant will then enter the evaporator through a throttle valve, it will rapidly evaporate, cool, and take up heat from its environment.
e) This solution will then be pumped back into the solar heater.
f) The refrigerant (e.g. ammonia) is more soluble in the carrier fluid (e.g. water) at low temperatures.

g) This process is also exothermic, thus the absorber will also reject some heat to the environment.
h) When this high pressure heated gas condenses, it will dissipate heat to its environment.

Now label items A and B on the diagram.

12. Answer these questions:

a) What does the word 'exothermic' mean? (Guess from its context in the paragraph.)
b) Why is the absorber located separately from the collector?

13. Read this:

Building materials in the hot climate zones

Cane and leaves are available in the warm-humid zones and grass in the intermediate and subtropical zones. Vine, bamboo and palm-fronds are used for buildings in the warm-humid zones. Because these materials are light, do not store heat, and allow the free passage of air, they are frequently used for making roofs. However, they have a relatively short life span because they deteriorate rapidly due to termite attack. They are also highly combustible.

Both hardwoods and softwoods are found in most tropical and subtropical areas with the exception of the hot dry zones. On external woodwork preservative stains should be used rather than paints which tend to deteriorate fairly rapidly in the hot zones. Extremes of climatic conditions cause dimensional changes producing cracks, splits and warping. Wind-blown sand and grit gradually erode exposed timber. In warm-humid zones timber is liable to wet and dry rot and to attack by termites and beetles.

Earth is one of the most widely used traditional building materials in hot-dry lands. Earth is used not only for walls but also for roofs; mud brick vaults and domes are common in countries like Iran and Egypt. Because mud has less strength than most other construction materials, mud walls are built thicker. Partly due to the thickness of mud walls and partly due to its low thermal conductivity, rooms built of mud are much cooler in hot climates than those of any other material. Mud bricks are brittle and do not withstand tension well. For this reason the vault and the dome were evolved in the East. There is a high risk of termite damage in some areas. Walls exposed to weathering and rain require frequent repair work.

Concrete and reinforced concrete are widely used throughout the non-temperate zones. Cement is manufactured locally in many places. Sand is found almost everywhere but it may be contaminated with soluble salts. Suitable aggregate may be difficult to find. Concrete is most frequently used for the structure, foundations and floor slabs of buildings. Care must be taken when using concrete for walls and roofs. Heat builds up on the exterior of concrete walls and roofs

due to solar radiation and surface temperatures usually exceed air temperatures. Then, because concrete walls tend to be thin and concrete has a low resistance to the passage of heat, heat is conducted into the interior. Salts in aggregates and water can cause corrosion of the reinforcement and subsequent spalling of the concrete cover. In hot-dry areas the rapid evaporation and shortage of water can result in low strength, cracking and high permeability.

Complete this table with notes about all the materials described above:

Material	Availability	Use	Properties	Problems/ Durability
Cane, leaves, vine, bamboo, palm-fronds	warm-humid zones			
Grass				
Hardwoods and softwoods				
Earth				
Concrete				

Glossary

This list gives the pronunciation of technical and semi-technical words used in this book and definitions of those words that are not fully explained in the text or diagrams. The number after each entry indicates the unit in which the word first appears.

Pronunciations are shown in the system that is used in the Longman *Dictionary of Contemporary English*. The symbols are shown in this table, with a key word for each. The letters printed in **bold type** represent the sound value of the symbol.

Consonants

p	pea	f	few	ʃ	fishing	h	hot
b	bay	v	view	ʒ	pleasure	m	sum
t	tea	θ	thing	tʃ	choose	n	sun
d	day	ð	then	dʒ	jump	ŋ	sung
k	key	s	soon	l	led	j	yet
g	gay	z	zoo	r	red	w	wet

Vowels

iː	sheep	ɔː	caught	eɪ	make	ɪə	here
ɪ	ship	ʊ	put	əʊ	note	eə	there
e	bed	uː	boot	aɪ	bite	ʊə	poor
æ	bad	ʌ	cut	aʊ	now	eɪə	player
ɑː	calm	ɜː	bird	ɔɪ	boy	əʊə	lower
ɒ	cot	ə	about			aɪə	tire
						aʊə	tower
						ɔɪə	employer

Notes

1. A small raised /ʳ/ at the end of a word means that the /r/ is pronounced if a vowel follows (at the beginning of the next word), but not otherwise. For example, *far* /fɑːʳ/ means that *far away* is pronounced /fɑːr əweɪ/ but *far down* is /fɑː daʊn/.
2. The italic /*ə*/ means that the sound /ə/ can be used but is often omitted. It may be found before the consonants /m, n, ŋ, l, r/ in certain positions. For example, *travel* /ˈtræv*ə*l/ means that the pronunciation /ˈtrævəl/ is possible but /ˈtrævl/ may be more common.
3. The mark /ˈ/ means that the following syllable has *main stress*, and /ˌ/ means that the following syllable has *secondary stress*. For example, *understand* /ˌʌndəˈstænd/

aggregate /'ægrɪgət/ gravel or broken stone used in concrete 4
air conditioner /'eəkən,dɪʃənəʳ/ 5
air lock /'eəlɒk/ air in pipework which is difficult to get out 8
altitude /'æltɪtju:d/ angular distance of a celestial object above the horizon 11
aluminium /,ælju'mɪnɪəm/ 1
ampere /'æmpeəʳ/ 4
angle /'æŋgəl/ 3
anthropometric data /,ænθrəpəmetrɪk 'deɪtə/ information about the body and reach characterisation of people 4
aquastat /'ækwəstæt/ 5
arc /ɑ:k/ 12
arch /ɑ:tʃ/ 1
architect /'ɑ:kɪtekt/ person who designs and supervises the construction of buildings 6
arcuated /'ɑ:kjueɪtɪd/ a building dependent structurally on the use of arches 3
artificial light /,ɑ:tɪfɪʃəl 'laɪt/ 5
asbestos /æs'bestəs/ 1
asphalt /'æsfælt/ mixture of bitumen and mineral matter occurring naturally 3
atmosphere /'ætməsfɪəʳ/ 8
auditoria /,ɔ:dɪ'tɔ:rɪə/ buildings in which audiences sit (singular: **auditorium**) 5
axis /'æksɪs/ 2

balcony /'bælkəni/ platform built on an outside wall of a building 4
balustrade /,bælə'streɪd/ collective name to the whole infilling from handrail down to the floor level at the edge of a building, stair, etc. 6
bamboo /,bæm'bu:/ fast-growing plant 12
barrier screen /'bærɪəskri:n/ 10
base plate /'beɪspleɪt/ plate to fix a stanchion to a concrete foundation 3
bay /beɪ/ area of concreting, tiling or screeding laid at one time 11
beam /bi:m/ structural member designed to carry loads between points of support 1
beetle /'bi:tl/ insect which damages timber 12
bitumen /'bɪtʃumən/ 1
bitumen felt /,bɪtʃumən 'felt/ sheets of fibres matted into a felt for roofing and treated with bitumen C
block /blɒk/ 1
boiler /'bɔɪləʳ/ device which burns fuel to produce heat 5
bolster /'bəulstəʳ/ tool for cutting bricks 11
boundary /'baundəri/ line around the edge of the site 2
brace and bit /,breɪs ənd 'bɪt/ 11
bracing /'breɪsɪŋ/ structural members which make a structure rigid 6
brick /brɪk/ hand-sized building block, mostly made from clay 1
bricklayer /'brɪk,leɪəʳ/ building tradesman who lays bricks 6
brickwork /'brɪkwɜ:k/ bricks built into a wall or other structure 6
brightness /'braɪtnəs/ 11
brush /brʌʃ/ tool for applying paint 11
building enclosure /'bɪldɪŋ ɪn,kləuʒəʳ/ 5
building materials /'bɪldɪŋ mə,tɪərɪəlz/ the material from which building elements are made 1
building site /'bɪldɪŋsaɪt/ land which is used, or will be used, for construction 2
burner /'bɜ:nəʳ/ part of a gas or oil boiler where the fuel burns 5

cable shears /'keɪbəl ʃɪəz/ 11
cane /keɪn/ grass-like plants 12
canopy /'kænəpi/ 2
cantilever /'kæntɪ,li:vəʳ/ structure with no support at one end or on one side 3
cap plate /'kæp pleɪt/ 3
carpenter /'kɑ:pəntəʳ/ building tradesman who works with wood 6
ceiling void /'si:lɪŋ vɔɪd/ space between a structural floor and a suspended ceiling 6
cellular /'seljuləʳ/ consisting of cells C
ceramics /sə'ræmɪks/ products made from fire clay 1
channel /'tʃænl/ 1
chimney effect /'tʃɪmni ɪ,fekt/ 10
chimney stack /tʃɪmnistæk/ brickwork containing one or more flues and projecting above a roof 2

chippings /'tʃɪpɪŋz/ B
chisel /'tʃɪzəl/ 11
circular /'sɜ:kjʊlə^r/ 1
cistern /'sɪstən/ water tank, e.g. tank for flushing w.c. (water closet) 8
cladding fixer /'klædɪŋ ˌfɪksə^r/ 6
clay /kleɪ/ earth that becomes hard when baked 1
client /'klaɪənt/ 6
climate zone /'klaɪmɪt zəʊn/ 7
coefficient of thermal conductivity /kəʊɪˌfɪʃənt əv ˌθɜ:məl ˌkɒndʌk'tɪvəti/ 9
column /'kɒləm/ an upright (vertical or near vertical) loadbearing member 1
column bases /ˌkɒləm 'beɪsɪz/ 3
combination pliers /ˌkɒmbɪ'neɪʃən'plaɪəz/ tool which can strip and cut electrical wire 11
combustible /kəm'bʌstəbəl/ (*adj*) can burn easily 1
component /kəm'pəʊnənt/ 1
compressive strength /kəm'presɪv streŋθ/ 1
compressor /kəm'presə^r/ 5
concentric scale /kən'sentrɪk skeɪl/ 11
concrete /'kɒŋkri:t/ material made from cement and aggregate 1
condenser /kən'densə^r/ device which removes water from air; the water condenses on to a cold surface 5
conductor /kən'dʌktə^r/ material which conducts electricity easily 1
cone /kəʊn/ 1
connecting plate /kə'nektɪŋ pleɪt/ 3
contract /'kɒntrækt/ (*noun*) 6
convection /kən'vekʃən/ 8
correction factor /kə'rekʃən ˌfæktə^r/ 11
corrosion /kə'rəʊʒən/ being destroyed by chemical action 1
corrugated /'kɒrəgeɪtɪd/ 1
cost /kɒst/ 6
cost target /'kɒst ˌtɑ:gɪt/ 6
courtyard /'kɔ:tjɑ:d/ rectangular space enclosed by buildings 2
cover /'kʌvə^r/ thickness of concrete covering steel reinforcement 4
crane /kreɪn/ 1
cross-section /'krɒs ˌsekʃən/ 1
cross-ventilation /'krɒs ventɪˌleɪʃən/ 12
crown /kraʊn/ 3
crushed marble /krʌʃt 'mɑ:bəl/ 11
cube /kju:b/ 1
cupboard /'kʌbəd/ small enclosed storage space with door or doors 2
curve /kɜ:v/ 3
cut-away view /'kʌtəweɪ vju:/ 2
cyclone zone /'saɪkləʊnzəʊn/ 10
cylinder /'sɪlɪndə^r/ 1

daylight /'deɪlaɪt/ 11
decibel /'desəbel/ 4
decorator /'dekəreɪtə^r/ building tradesman who paints a building 6
defects liability period /ˌdi:fekts laɪə'bɪlɪti ˌpɪərɪəd/ 6
deflection /dɪ'flekʃən/ 7
dimension /daɪ 'menʃən/ measurement of any sort (breadth, length, thickness, height, etc.) 4
direct solar radiation /dəˌrekt 'səʊlə reɪdiˌeɪʃən/ 7
down pipe /'daʊnpaɪp/ rainwater pipe fixed vertically to a wall 2
draught /drɑ:ft/ the pressure difference causing a current of air 10
draw-off point /'drɔ: ɒf pɔɪnt/ tap by which pipework may be emptied of water 8
dry rot /ˌdraɪ 'rɒt/ (*merulius lacrymans*) fungus which destroys timber 8
duct /dʌkt/ 8

earth /ɜ:θ/ any soft, fine material with vegetable content dug from the ground 12
elastic /ɪ'læstɪk/ 1
electrician /ɪ'lek'trɪʃən/ building tradesman who installs electrical wiring and fittings 6
elevation /ˌelɪ'veɪʃən/ 2
estimate /'estəmət/ an approximate calculation 6
excavate /'ekskəveɪt/ remove earth by digging 6
expanded polystyrene /ɪksˌpændɪd pɒli'staɪəri:n/ an insulating material 9
exterior /ɪk'stɪərɪə^r/ 2
external envelope /ɪkˌstɜ:nəl 'envələʊp/ 5

feed tank /'fi:d tæŋk/ 8
felt (see **bitumen felt**) C
fibreboard /'faɪbəbɔ:d/ boards built up by felting from wood or other vegetable fibre B
file /faɪl/ 11
finish /'fɪnɪʃ/ final covering of a

surface so that it is attractive, hardwearing and easily cleaned 6
fire escape /'faɪərɪ,skeɪp/ 10
fire resistance /'faɪə rɪ,zɪstəns/ 5
flashing /'flæʃɪŋ/ strip of impervious material used to make a weathertight joint 13
flexible /'fleksəbəl/ 1
float /fləʊt/ 11
floor boarding /'flɔ:bɔ:dɪŋ/ 1
flue /flu:/ duct which carries burnt gases from a boiler up into the air outside the building 2
foreman /'fɔ:mən/ person who supervises other tradesmen 6
foundation /faʊn'deɪʃən/ solid part of a building under the ground which transmits the load of a building to the earth 2
frame /freɪm/ 3

germicidal treatment /'dʒɜ:mɪsaɪdl ,tri:tmənt/ using a substance to destroy germs, especially bacteria 5
Gio Ponti /,dʒɪəʊ 'pɒnti/ famous Italian architect A
girder /'gɜ:dəʳ/ large beam 7
glare /gleəʳ/ 12
glass wool /,glɑ:s 'wʊl/ flexible fibres formed from molten glass and used as an insulator 1
glazed /gleɪzd/ A
glazier /'gleɪzɪəʳ/ building tradesman who cuts glass and fixes it in a window or door 6
glue /glu:/ liquid used for sticking materials together 3
Golden Section /'gəʊldən ,sekʃən/ 12
gravel /'grævəl/ small stones 8
gutter /'gʌtəʳ/ channel along the edge of a road or an eave to remove rainwater 2

hacksaw /'hæksɔ:/ 11
hardcore /,hɑ:d'kɔ:/ loose fill material which will not settle once compacted 8
hardwood /'hɑ:dwʊd/ timber from a tree with a broad leaf 12
heat transfer /'hi:t ,trænsfɜ:ʳ/ 9
heating contractor /'hi:tɪŋ kən,træktəʳ/ 6
hemisphere /'hemɪsfɪəʳ/ 1
high alumina cement /,haɪ ə,lu:mɪnə sɪ'ment/ 8

horizontal /,hɒrɪ'zɒntl/ 3
hurricane /'hʌrɪkən/ 10
hygrometer /haɪ'grɒmɪtəʳ/ 11

illumination /ɪ,lu:mɪ'neɪʃən/ 4
impermeable /ɪm'pɜ:mɪəbəl/ 1
interior /ɪn'tɪərɪəʳ/ 2
internal division /ɪn'tɜ:nl dɪ,vɪʒən/ 5
iron /'aɪən/ 1

joiner /'dʒɔɪnəʳ/ craftsman who makes components out of wood 6
joint /dʒɔɪnt/ 3
joist /dʒɔɪst/ structural timber forming a floor or ceiling 3
joule /dʒu:l/ 4

k-value /'keɪ ,vælju:/ C
kilogramme /'kɪləgræm/ 4

lateral restraint /,lætərəl rɪ'streɪnt/ prevent from moving sideways C
Le Corbusier /lə kɔ:'bu:sjeɪ/ famous French architect 12
lightning conductor /'laɪtnɪŋ kən,dʌktəʳ/ a thick copper lead connected to earth, projecting above a building, which reduces the chance of the building being struck by lightning 10
lintel /'lɪntl/ structural support over an opening in a loadbearing wall 3
load /ləʊd/ 5
loadbearing wall /'ləʊdbeərɪŋ wɔ:l/ 3
longitudinal section /lɒndʒɪ'tju:dənəl ,sekʃən/ 1
louvre /'lu:vəʳ/ horizontal sloping slats which allow ventilation 5
lumen /'lu:mən/ 4
luminous flux /'lu:mɪnəs flʌks/ 4
lump hammer /'lʌmp ,hæməʳ/ 11
lux /lʌks/ 4

mallet /'mælɪt/ 11
membrane /'membreɪn/ 1
Mies van der Rohe /,mi:z væn də 'rəʊə/ famous German architect A
mineral wool /'mɪnərəl wʊl/ insulation made into a quilt or slab 5
moisture /'mɔɪstʃəʳ/ liquid in the form of vapour 1
mortar /'mɔ:təʳ/ binding material for use with bricks and blocks 3
mortar bed /'mɔ:tə bed/ layer of

mortar on which a brick or other item is laid 3

mortise-and-tenon /ˌmɔːtɪs ənd ˈtenən/ a joint usually between members at right angles to each other 11

mould /məʊld/ 11

natural light /ˌnætʃərəl ˈlaɪt/ 5

newton /ˈnjuːtən/ 4

nomogram /ˈnɒməgræm/ 11

non-combustible /ˌnɒnkəmˈbʌstəbəl/ (*adj*) does not burn 1

opaque /əʊˈpeɪk/ 1

ordinary Portland cement /ˌɔːdənri ˌpɔːtlənd sɪˈment/ a yellowish cement made from a burned mixture of clay and limestone 11

orientation /ˌɔːrɪənˈteɪʃən/ 2

outer sheathing /ˌaʊtə ˈʃiːðɪŋ/ 11

overhanging eaves /ˌəʊvəhæŋɪŋ ˈiːvz/ rafters, tiles, slates, etc. projecting over the wall plate and clear of the wall 12

paint /peɪnt/ decorative finish applied with a brush or roller 8

panel /ˈpænl/ portion of a floor, roof slab or wall supported by a frame 1

panel saw /ˈpænl sɔː/ 11

parallel /ˈpærəlel/ 2

party wall /ˌpɑːtiˈwɔːl/wall between two houses or other buildings, and jointly owned 8

pedestrian access /pəˈdestrɪən ˌækses/ way for people on foot to get into a place or building 2

perimeter /pəˈrɪmɪtəʳ/ 2

permeable /ˈpɜːmɪəbəl/ 1

perpendicular /ˌpɜːpənˈdɪkjʊləʳ/ 2

pincers /ˈpɪnsəz/ 11

pipe /paɪp/ tube used to carry liquids and gases 1

pipework /ˈpaɪpwɜːk/ 6

plan /plæn/ 2

planar construction /ˈpleɪnɑː kənˌstrʌkʃən/ 1

plane /pleɪn/ 11

plastic /ˈplæstɪk/ 1

pliers (see **combination pliers**)

plumb-bob /ˈplʌm bɒb/ tool to check that something is vertical 11

plumber /ˈplʌməʳ/ building tradesman who works with pipework and flashings 6

pollution /pəˈluːʃən/ 5

polythene /ˈpɒlɪθiːn/ type of plastic 1

porch /pɔːtʃ/ projecting or recessed covered space at the entrance to a building 2

porous /ˈpɔːrəs/ 8

post-and-lintel /ˌpəʊst ənd ˈlɪntl/ 3

precast concrete /priːˌkɑːst ˈkɒŋkriːt/ concrete cast in a factory and transported to the place it is needed 3

precipitation /prɪˌsɪpɪˈteɪʃən/ fall of rain, sleet, snow or hail 5

preservative stain /prɪˌzɜːvətɪv ˈsteɪn/ a protective finish for wood 12

prevailing wind /prɪˈveɪlɪŋ wɪnd/ direction from which a wind most frequently comes 8

prism /ˈprɪzəm/ 1

profiled /ˈprəʊfaɪld/ 3

protractor /prəˈtræktəʳ/ 11

radiator /ˈreɪdieɪtəʳ/ type of heat emitter 5

rapid-hardening cement /ræpɪd ˌhɑːdnɪŋ sɪˈment/ 11

rectangular prism /rekˌtæŋgjʊlə ˈprɪzəm/ 1

reflection coefficient /rɪˌflekʃən kəʊˈfɪʃənt/ 11

reinforced concrete /ˌriːɪnfɔːsd ˈkɒŋkriːt/ 4

relative humidity /ˌrelətɪv hjuːˈmɪdəti/ 5

rib /rɪb/ 4

rigid /ˈrɪdʒɪd/ 1

rod /rɒd/ 1

roof decking /ˈruːf ˌdekɪŋ/ lightweight panels used to form a roof 6

rubber /ˈrʌbəʳ/ 1

safety valve /ˈseɪfti vælv/ 5

sanitary fittings /ˈsænɪtəri ˌfɪtɪŋz/ fittings used to remove dirt and waste 6

scale /skeɪl/ the deposit of magnesium or calcium salts formed in a pipe 4

screen /skriːn/ a fence or wall which closes off a view, often to make a space more private 6

screwdriver /ˈskruːˌdraɪvəʳ/ tool for tightening screws 11

seasonal variation /ˌsiːzənəl veəriˈeɪʃən/ 7

section /ˈsekʃən/ 1
security /sɪˈkjuərəti/ protection from thieves 5
segmental arch /seg,mentl ˈɑ:tʃ/ a segmental arch is formed by a segment of a large circle drawn from a centre below the springing line 3
seismic area /ˈsaɪsmɪk ,eərɪə/ 10
semi-circular /,semɪˈsɜ:kjuləʳ/ 1
sheet /ʃi:t/ 1
shovel /ˈʃʌvəl/ hand tool for moving earth 11
shutter /ˈʃʌtəʳ/ a wooden or steel cover that fastens over a window 2
sill /sɪl/ bottom of a window; the sill allows water to drip off the window without running down the side of the building B
slab /slæb/ 1
softwood /ˈsɒftwud/ timber from a tree with a pinnate leaf 12
solar collector /,səulə kəˈlektəʳ/ device which collects solar radiation and converts it into heat 12
solar radiation /,səulə reɪdiˈeɪʃən/ radiant energy received from the sun 12
solid angle /,sɒlɪd ˈæŋgəl/ an angle formed in three dimensions 11
soluble sulphates /ˈsɒljubəl ˈsʌlfeɪts/ 8
sound insulation /ˈsaund ɪnsju,leɪʃən/ 5
spalling /ˈspɔ:lɪŋ/ 4
span /spæn/ the distance between supports 3
spanner /ˈspænəʳ/ 11
specification /,spesɪfɪˈkeɪʃən/ written description of work to be done 6
spirit level /ˈspɪrɪt ,levəl/ 11
split /splɪt/ a crack in wood which passes through it 12
springing line /ˈ sprɪŋɪŋ laɪn/ the level at which an arch springs from its supports 3
square /skweəʳ/ 1
squareness /ˈskweənəs/ 11
stability /stəˈbɪlɪti/ the resistance of a structure to sliding, overturning, or collapsing C
stanchion /ˈstɑ:ntʃən/ steel column 1
stanchion casing /,stɑ:ntʃən ˈkeɪsɪŋ/ material covering a steel column usually to protect it from fire B
steel /sti:l/ 1
steel skeleton / ,sti:l ˈskelətn/ steel frame for a building 3
steelwork /ˈsti:lwɜ:k/ 6
strain /streɪn/ amount of dimensional change caused by a force 8
stress /stres/ force per unit area 8
strip /strɪp/ 1
structure /ˈstrʌktʃəʳ/ loadbearing part of a building 1
subsided /səbˈsaɪdɪd/ moved downwards 8
suspended floor /səsˈpendɪd ,flɔ:ʳ/ floor which does not rest on the ground 5

tender figure /ˈtendə ,fɪgəʳ/ 6
tensile strength /ˈtensaɪl ,streŋθ/ 1
termite /ˈtɜ:maɪt/ insect which eats wood 10
terrace /ˈterəs/ raised level platform 2
terrazzo /təˈrætsəu/ concrete floor finish containing chips of marble (a type of stone) 11
thermal conductance /,θɜ:məl kənˈdʌktəns/ C
thermal insulation /,θɜ:məl ɪnsjuˈleɪʃən/ 5
thermal resistance /,θɜ:məl rɪˈzɪstəns/ C
thermostat /ˈθɜ:məstæt/ switch which goes off and on as the temperature in the room rises and falls 5
tile /taɪl/ 1
timber /ˈtɪmbəʳ/ wood used in building 3
tongued and grooved /,tʌŋd ənd ˈgru:vd/ C
trabeated /ˈtreɪbieɪtɪd/ (*adj.*) constructed on the post-and-lintel principle 3
transparent /trænˈspærənt/ able to be seen through 1
transverse section /trænzˈvɜ:s ,sekʃən/ cross section 2
triangular /traɪæŋgjuləʳ/ 1
trowel /ˈtrauəl/ tool used to apply sand/cement mixture 11
truss /trʌs/ assembly of structural roof members which may be prefabricated 7
tube /tju:b/ 1

U-value /ˈju: ,vælju:/ C

vault /vɔːlt/ an arched masonry roof 3
vehicular access /viːˈhɪkjʊlər ˌækses/ way for vehicles to get into a place or building 2
vent pipe /ˈvent paɪp/ an outlet for air 8
verandah /vəˈrændə/ a covered outdoor space open on one or more sides extending from a building 12
vertical /ˈvɜːtɪkəl/ 3
verticality /ˌvɜːtɪˈkælɪti/ 11
vice /vaɪs/ 11
vinyl /ˈvaɪnəl/ type of plastic 3

warping /ˈwɔːpɪŋ/ any distortion of timber caused by changing the moisture content 12
waste pipe /ˈweɪst paɪp/ small pipe carrying waste water from a basin, bath or sink 2
weather resistance /ˈweðə rɪˌzɪstəns/ 5
weld /weld/ 3
wet rot /ˈwet rɒt/ fungus which destroys timber which has become wet 8
window head /ˈwɪndəʊ hed/ top part of a window B
wire strippers /ˈwaɪə ˌstrɪpəz/ tool for removing the insulation from electrical wiring 11

zinc /zɪŋk/ 1

TEACHER'S NOTES

UNIT 1 **Properties and Shapes**

Aims

To present and practise ways of expressing shapes and properties in describing the appearance of buildings, their components and the materials used to make them.

Main language items

Descriptive statements in the simple present:

Noun phrase + *be* + (*shaped like* + noun phrase/adjective + *in shape*/noun-*shaped*/adjective): e.g. *The brick is shaped like a rectangular prism. The cross-section of a brick is rectangular in shape. The minaret is pencil-shaped. The column is solid.*

Noun phrase + *have* + noun phrase: e.g. *The building has five flat external surfaces.*

Statements of property:

Noun phrase + *be* + adjective: e.g. *Steel is elastic.*

Noun phrase + *have* + *the property of* + noun phrase: e.g. *Steel has the property of high tensile strength.*

Connectives used in comparing and contrasting: *both . . . and; neither . . . nor; but, whereas, however, on the other hand*

Phrases of restatement: *this means; in other words; i.e.*

Notes

SECTION 1

In architecture, shape is usually thought of as two dimensional and form as three dimensional. Thus form can be defined as a three-dimensional shape. However, the two terms are often used interchangeably.

After completing Exercise 1 present this table of the adjectival form of the three-dimensional shapes:

NOUN	ADJECTIVE
cube	cubic
hemisphere	hemispherical
prism	prismatic
pyramid	pyramidal
cone	conical
cylinder	cylindrical

Then repeat Exercise 1 making sentences like this: *The brick is prismatic in shape.*

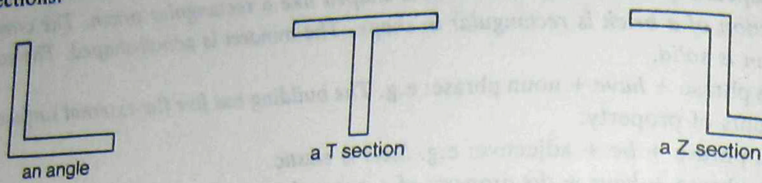
Architects also attempt to describe the spaces created by the ordering of solid forms. Some architects prefer to use the word 'cavity' when describing the internal space of a building. Spaces can have names which may or may not describe their form, such as: *courtyard, room, hall, dome, drum, vault.* So, for example, when an architect is talking about a *barrel vault*, he is thinking about the cavity it makes, but this cavity is formed by the cylindrical surface of the vaulted ceiling. This rather sub-

tle concept could generate a lot of discussion with the more advanced students.

In Exercise 2, after looking at the two-dimensional shapes, check that the students know the noun forms: *square, circle, semi-circle, rectangle* and *triangle.*

Line is the outline, edge, junction of surfaces, or joints of buildings. Check that the students know these different sorts of lines: *straight, bent, horizontal, vertical, parallel, tapering, diagonal, zigzag, inclined, sloping, oblique.*

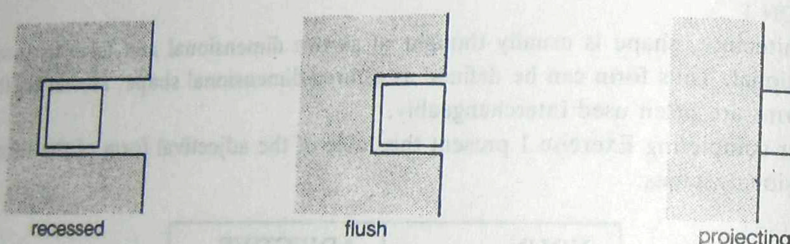
In Exercise 3*b*), students should be informed that a steel beam can be made with many different shapes in cross-section. The steel beam illustrated has an I-shaped cross-section; other common possibilities are angles (L-shaped), T sections and Z sections:



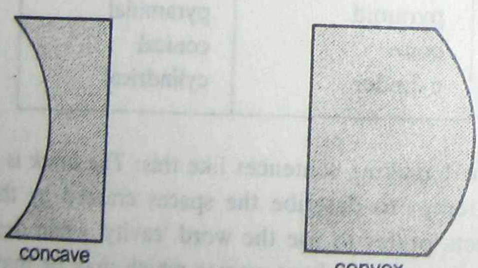
Note that the steel channel shown could also be used as a beam. All these sections have many different uses apart from beams and may be made of other materials apart from steel such as aluminium or wood.

In Exercise 3*f*) the term *diamond-shaped* is replaced by *lozenge-shaped* by some architects.

For Exercises 4 and 5 other terms which are useful when describing the shape of a building and its components are:



e.g. The column is *recessed into* the wall
The column is *flush with* the wall
The column is *projecting from* the wall



Note also that some building materials are formless, for example the powders such as cement, and liquids such as paint. The distinction could be illustrated by con-

structing the following table* on the board:

Formed materials	Formless materials
Natural stone	Aggregates:
Precast concrete	crushed stone
Clay (dried, fired)	gravel
Metal	sand
Wood	Lime and cement
Vegetable and animal materials:	binders
fibre building board	Mortars
paper	Concretes
grasses	Gypsum plasters
hessian	Bituminous materials:
bark, cork	asphalt
hair, wool, leather	bitumen
Inorganic fibres:	tar
glass wool/fibres	pitch
asbestos wool/fibres	Paints
carbon fibres	Adhesives
Rubber	Preservatives
Plastics	Water
Glass	Cleaning materials
	Gases

* (for a complete list of materials see the *Construction Industry Thesaurus*)

Exercise 5 should generate a lot of discussion. The shape of most buildings can be described in terms of a combination of the basic forms. Encourage the students to produce sentences like this: *The Egyptian house is cubical and has a roof shaped like a hemisphere.*

The buildings in one locality tend to have the same characteristic forms. See if these forms can be discovered during this discussion.

Answers to exercises

Exercise 1

a) pyramid *b*) . . . is shaped like a cone *c*) . . . is shaped like a hemisphere *d*) . . . is shaped like a cylinder *e*) . . . is shaped like a rectangular prism *f*) . . . is shaped like a triangular prism *g*) . . . is shaped like a cube.

Exercise 2

The cross-section of the { brick is rectangular / hotel is square / top of the minaret is circular / column is circular / church is triangular } in shape.

The longitudinal section of the	brick is rectangular hotel is triangular top of the minaret is triangular column is *rectangular* church is rectangular	in shape.

Exercise 3
a) the minaret *b*) the steel beam *c*) the steel channel *d*) the dome of the mosque *e*) the Arabic arch *f*) the church

Exercise 4
a) The church is hollow. It has four flat external surfaces. *b*) The slab is solid. It has six flat surfaces. *c*) The column is solid. It has two flat surfaces and one curved surface. *d*) The mosque is hollow. It has four flat external surfaces and one curved external surface. *e*) The steel beam is solid. It has eight flat surfaces.

SECTION 2
For Exercise 6, read through the captions to the diagrams. The diagrams should make the meaning of the various adjectives clear, but, if necessary, check the students' understanding by giving the equivalent in their first language.

Note that the meaning of *elastic* and *plastic* is rather different in building construction than in general English. Most materials are elastic up to a certain load after which they become plastic.

Once the students have understood these adjectives and mastered their pronunciation ask them to match the diagrams with the sentences. This matching is done mainly by looking at the drawing for the building component mentioned. After that, the students should complete the sentences. Point out the ways of restating: *this means*, *in other words* and *i.e.* (which is often spoken as *that is*). For more advanced students point out the use of *this means* as a way of indicating the significance or implication of something, e.g. *Water is coming through that wall! This means the wall is permeable.*

To extend the exercise get the students to give more examples of the different kinds of material. Build up a list on the board and check that they know the noun forms of the adjectives (see the table on the following page).

They can then ask and answer:
S1: Which of these materials is very light?
S2: Nylon and rubber.
S3: Which of these materials is the best conductor of heat?
S4: Copper, *etc.*

Also:

Which is heavier, lighter, harder, softer, a better conductor of heat, a worse/poorer conductor of heat, copper or cast iron? *etc.*

Introduce the use of *relatively* in this oral practice: *If we say aluminium is a relatively light metal, this means that it is light compared with most other metals.*

Noun	Adjective	Examples of materials
weight	a *light* material a *heavy* material	*aluminium, magnesium lead, copper
flexibility *rigidity*	a *flexible* material a *rigid* material	thin sheets of metal, plastics stone, cast iron
combustibility	a *combustible* material	rubber, plastic
fire resistance	a *non-combustible* material	clay, glass
transparency	a *transparent* material	water, some plastics
opacity	an *opaque* material	stone
corrosion resistance	a *corrosion resistant* material a material which is *not corrosion resistant*	zinc, chromium, tin cast iron
conductor *conductivity*	a good *conductor* of heat a poor *conductor* of heat	silver rubber
elasticity	an *elastic* material	nylon
plasticity	a *plastic* material	copper, aluminium
softness	a *soft* material	rubber, nylon
hardness	a *hard* material	cast iron

* Note that it is strictly more accurate to say that aluminium has a low mass, etc., but these terms are used.

Use this section to help with the introduction of Unit 9. Introduce: *Nylon is hard compared with rubber but soft compared with glass.* etc.

Exercise 7 introduces four new properties. Point out that the adjectives *compressive* and *tensile* are formed from the nouns *compression* and *tension*. Note that these sentences can be changed into definitions, e.g.

A material which can resist high compressive forces

possesses }
has } the property of high compressive strength.
exhibits }

Other mechanical properties besides tensile and compressive strength are *shear*, *bending* and *bearing* strength.

Exercise 8 is a simple reasoning exercise. It can be done orally initially, and the

students should be encouraged to discuss the answers. It can be extended to other properties and the nouns of all the properties introduced, e.g.

Why are aeroplanes made of aluminium?

Because aluminium has a low mass.

Answers

Exercise 6

a) impermeable *b*) corrosion resistant *c*) heavy *d*) a good conductor of heat *e*) a poor conductor of heat *f*) hard *g*) non-combustible *h*) opaque

Exercise 7

Steel has the property of high tensile strength. This means it can resist high tensile forces.

Stone has the property of high compressive strength. This means it can resist high compressive forces.

Glass wool has the property of good thermal insulation. This means it does not transmit heat easily.

Brick has the property of good sound insulation. This means it does not transmit sound easily.

Exercise 8

a) transparent *b*) good thermal insulation *c*) is corrosion resistant *d*) non-combustible *e*) rigid *f*) concrete has the property of high compressive strength

SECTION 3

Before the students read the passage, they should be encouraged to look at and discuss the diagrams illustrating three different types of construction. The word *planar*, the adjective of *plane*, should be explained, and the following terms introduced and explained: *support the loads*, *divide the space*, *put together*, *fixed together*. Blocks are put together because there is not usually any structural connection between them, whereas in frame and planar construction the parts are joined structurally.

After this introduction, students should read the passage silently. Students should then work out in pairs or in groups which paragraph refers to which type of construction. The teacher should then go over the answers encouraging discussion.

The great architectural revolution of this century was the separation of the space dividing from the structural support function by using frame construction. This enabled a great deal of freedom in how space was divided in a building. With more advanced students the advantages and disadvantages of the three types of construction could be discussed particularly in terms of the following properties: *weight*, *fire resistance*, *sound* and *thermal insulation*. Also, exceptions to the table in Exercise 10 can be discussed, e.g. a log cabin is made of rod materials which act as both space dividers and structural support. However, that is not an *efficient* use of material. The concept of efficiency could be introduced and discussed here. Related to this are the more modern types of construction which could be introduced here and discussed in greater detail in Unit 3. They are *space structures*, *stressed skin structures*, *shell*

structures and *air supported structures*, which all try to use the minimum amount of material to span an area.

Answers

Exercise 9

a) paragraph 2 *b*) paragraph 3 *c*) paragraph 1

Exercise 10

Form of material	Function of components: Structural support only	Space dividing only	Both structural support and space dividing
Blocks			✓
Sheets		✓	✓
Rods	✓		

Exercise 11

a) False. Rod materials can only be used for supporting the building.

b) True.

c) False. Steel is used for frame construction because it has high tensile and compressive strength.

d) True.

e) False. Mass construction buildings are heavy whereas planar construction buildings are light.

SECTION 4

Before the students listen to the passage, they should study the diagrams of building components. Make sure that they understand that the exercise is to try and classify these building components into three types. With the teacher playing the part of the Instructor and two students playing the parts of Student 1 and Student 2, the dialogue should be acted out. Act it out again with two different students and then check that the students understand the difference between a section, a unit and a compound unit. The strict definition of a section is as follows: *A product usually formed by a continuous process to a definite cross-section which is small in relation to its length.* A section then has a definite two-dimensional shape and is of indeterminate length whereas a unit has a definite three-dimensional shape. Sometimes the term *sectional component* is used to distinguish it from *section* as in *cross-section*. The students should now copy and complete the table and then complete the sentences in Exercise 14. The dialogue should be acted out a third time with a student playing the part of the instructor. Students should then attempt to draw a sketch of the compound unit described towards the end of the dialogue.

As an extra exercise ask students to go outside the classroom and look in detail

at the different buildings around them. They should draw sketches of the sections, units and compound units used to make them. The students' descriptions of the building components should follow the model description of a timber wall panel in the dialogue.

Listening text

INSTRUCTOR: Right. Today, I'd like you to answer some questions about the different types of components used in buildings. Now then, who can tell me the names of the three different types of components?

STUDENT 1: Umm. . . I think they are units, compound units and tubes.

INSTRUCTOR: No, that's not quite right — who can tell me which one of those three is not correct?

STUDENT 2: Er. . . Well, a tube is only an *example* of a sectional component. The three types of components are sections, units and compound units.

INSTRUCTOR: Yes, that's right. Now can you describe a section for me?

STUDENT 2: Yes, umm. . . A section is a component with a cross-section of a definite shape — for example I-shaped or square-shaped. Sections are made in long pieces and then cut to the required lengths.

INSTRUCTOR: Good. Now who can describe a unit and a compound unit?

STUDENT 1: Umm. . . I know this. A unit is formed as a simple three-dimensional shape — such as, for example, a rectangular prism — whereas a compound unit is made from combinations of sections and units.

INSTRUCTOR: Very good. Now to make this clear, could you describe an example of a compound unit please?

STUDENT 1: Umm. . . Let me think. Well, a timber wall panel is made from solid rectangular-shaped sections and flat boards. The rectangular sections support the wooden boards and the boards act as space dividers. Because it is made from a combination of sectional components, it is an example of a compound unit.

INSTRUCTOR: Yes. That's very good. Thank you.

Answers

Exercise 13

	Section	Unit	Compound unit
Name of component	Tube Floor boarding Rolled metal sheet Timber strip Steel column	Brick Block Panel Tile Pipe	Door and frame Steel stanchion Window

Exercise 14

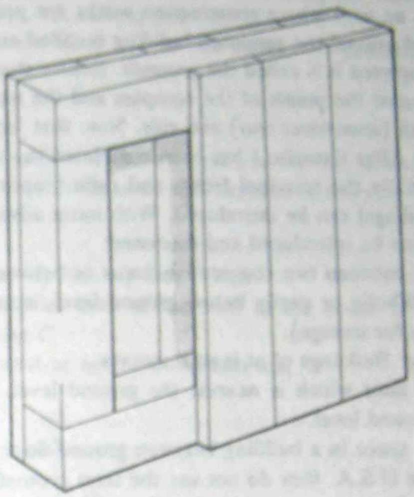
a) . . . section . . . made in a long piece and then cut to the required length.

b) . . . unit . . . it is made as a simple three-dimensional shape.

c) . . . compound unit . . . it is made from a combination of sections and units.

Exercise 15

Sketch of compound unit



UNIT 2 Location

Aims

To introduce and practise expressions describing the location of a building on a site and the positions of rooms and building components within a building.

Main language items

Statements of position:

be + preposition + noun phrase: e.g. *The bathroom is next to the bedroom.*

Verbs associated with position: *face, be bounded by, be orientated, runs along, extends, be located, be situated, place, occupy, leads*

Preposition and prepositional phrases expressing position; *in relation to*, and the idea of relative position.

Technical drawing terms: *plan, elevation, section, cut-away view*

Definiteness – the contrast between: *There is a* + noun phrase + prepositional phrase and *The* + noun phrase + *is* + prepositional phrase.

Use of *So what!* and *Does that matter?* to prompt further reasoning.

Pointer words: *this, that, these, those, here, there*

Notes

SECTION 1

Exercise 1 deals with the terms used to discuss the location of a building on a site. Note that a *site* is an area where construction works are proposed or undertaken. The area of ground around the proposed building is called *external works* but when the building is completed it is called the *grounds*. Before starting Exercise 1, check that the students know the points of the compass and the names for the faces of a building: *front, back* (sometimes *rear*) and *side*. Note that *face* can be used as both a noun and a verb. After Exercise 1 has been completed the terms *facade* (the faces of a building especially the principal front) and *soffit* (exposed under-surfaces, including those of ceilings) can be introduced. With more advanced students the following terms can also be introduced and discussed:

Storeys: The spaces between two consecutive floors or between a floor and a roof.

Basement storeys: Wholly or partly below ground level, normally living spaces (a *cellar* is used only for storage).

Multi-storey building: Buildings of at least 6 storeys.

Ground floor: The floor which is nearest the ground level. It is generally about 300 mm above ground level.

Ground storey: The space in a building between ground floor and first floor.

Note also that in the U.S.A. they do not use the term *ground floor* – you enter the building on the first floor.

For Exercise 3, ask students to draw a sketch of a local building site. They should take Exercise 2 as the model paragraph. Exercise 4 explores why buildings are orientated the way they are. Depending on the climate, buildings are orientated to regulate the amount of exposure to sun and wind. In warm-humid climates architects try to determine the optimum orientation for a building which will minimise the intensity of solar radiation and maximise cross-ventilation. You can point out to more advanced students that although the greatest pressure on the windward side of a building is generated when the facade is perpendicular to the wind direction, it has been shown that if windows are positioned at 45° to the wind direction the average indoor air velocity is increased and a better distribution of indoor air movement is provided. This approach may help to resolve orientation problems when the solar and wind requirements are contradictory and a best compromise must be reached. Find out the direction of local prevailing winds and see if local buildings tend to be orientated in any one particular direction.

Exercise 5 should generate a lot of discussion about the other factors affecting the orientation of buildings and is a good chance to practise the terms used to describe geographical location. In the centre of a town, because of shortage of space, there may be no possibility of changing the orientation of a building. Some buildings are orientated for a particular view or for monumental reasons at the end of an avenue.

Answers to exercises

Exercise 1

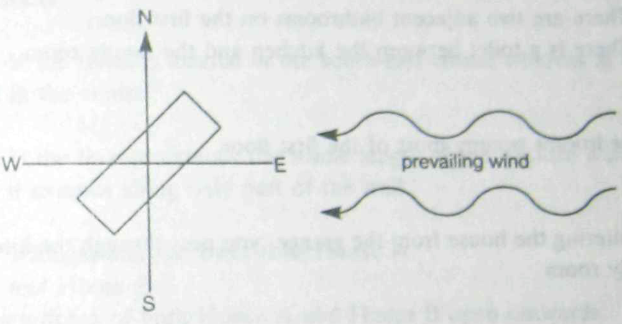
a) . . . faces east . . . an east facing wall.
b) . . . face north and south . . . north and south facing walls.
c) . . . is orientated north-south . . . of the short axis is north-south.
d) . . . face east and west to minimise the area of wall exposed to the sun.
e) . . . is bounded by . . . to the north . . . runs along the northern boundary.
f) . . . a railway line . . . A railway line . . .
g) . . . pedestrian access from . . . to the south . . . pedestrian access from the north, west or east.

Exercise 2

rectangular . . . an irrigation ditch . . . a railway line . . . a road . . . road . . . runs along . . . orientated . . . the area of wall exposed to the sun.

Exercise 4

a) east–west *b*) Yes *c*) No *d*) east – west
e) Yes. Because a smaller area of the wall of the house is exposed to the sun.
f) House D *g*) House C
h) north-east–south-west or north-west–south-east



SECTION 2

For Exercise 6, if you can get the students to make a model of the house in the diagram, this would greatly assist the explanation of the technical drawing terms *plan*, *elevation*, *section* and *cut-away view*. Its use will also enliven the presentation of the building vocabulary and the statements of position. Note that window openings are the holes in the walls whereas windows are constructions for closing the holes. Make sure the students understand why the south elevation is drawn with the chimney on the right and the north elevation with the chimney on the left (because that is how you would see the house looking from the south or north). Question *d*) involves comparing the north and south elevations – no canopy is indicated above the door on the north elevation, so the back door does not have a canopy over it.

The drawings in Exercise 7 are of a typical house in the U.S.A. and it is a chance to discuss and compare living arrangements in different countries. The true/false statements introduce the terms: *is located*, *is situated*, *occupy*, *pass through . . . to*

enter, and *leads to*. To practise these terms get the students to make sentences about the house in Exercise 6.

After completing Exercise 9, look at a selection of different local buildings and discuss the reasons for the relative location of rooms.

For Exercise 10, two students should act out the example conversation in front of the class. Encourage them to extend the conversation further if possible. Discuss the function of *So what!* and *Does that matter?* as devices to prompt a person to supply further reasons for their opinions. Students should work in pairs constructing similar conversations which they can practise and then act out in front of the class.

Answers

Exercise 6

a) the north elevation *b*) the front wall *c*) the side walls *d*) No *e*) the kitchen window *f*) the living room window *g*) looking south, the living room is on the left of the house *h*) the kitchen *i*) a waste pipe *j*) at the top *k*) a fireplace *l*) shutters *m*) a fireplace *n*) the chimney stack *o*) the bathroom and kitchen *p*) the flue *q*) the bedroom *r*) the gutter *s*) on the right of the house

Exercise 7

a) True.
b) True.
c) False. There are two adjacent bathrooms on the first floor.
d) False. There is a toilet between the kitchen and the family room.
e) True.
f) True.
g) False. Bedrooms occupy most of the first floor.
h) True.
i) True.
j) False. Entering the house from the garage, you pass through the kitchen to enter the family room.
k) True.
l) True.
m) True.

Exercise 8

a) Viewed from the front, the kitchen is behind the dining room.
b) Bathroom 1 is above the kitchen.
c) There is a cupboard between bedroom 2 and bedroom 3.

Exercise 9

a) C *b*) D *c*) A *d*) B

SECTION 3

The reading passage is straightforward and students should have no difficulty labelling the rooms in House A. The passage provides a model for the description of House B which should be done orally first.

Exercises 13 and 14 revise the structures of comparison: *whereas; both . . . and; neither . . . nor*

Answers

Exercise 11

a) dining area *b*) living room *c*) kitchen *d*) hall *e*) toilet *f*) bedroom *g*) bathroom *h*) bedroom

Exercise 12

The house is a single-storey building with a rectangular-shaped plan. It contains eight rooms. The entrance which is located on the south side leads into a hall. On the left of the hall is the living room and beyond that in the south-west corner is the dining area. The kitchen is adjacent to the dining area. A terrace is situated outside the kitchen on the west side. A bathroom is located in the centre of the house. Access to the bathroom is from the hall. The two bedrooms are located on the north side with a study between them. There is also an entrance to the kitchen on the west side.

Exercise 13

a) House A.
The front door of House A opens inwards whereas the front door of House B opens outwards.

b) House B.
In House B the toilet is located in the south-east corner whereas in House A it is located in the centre.

c) House B.
In House B the terrace extends the whole length of the western wall whereas in House A it extends along only part of the wall.

d) House B.
House B is longer and narrower than House A.

e) House A and House B.
The kitchen doors of both House A and House B open outwards.

f) House A.
The bathroom in House A has a window whereas the bathroom in House B does not.

g) House B.
House B has a study whereas House A does not.

h) House A and House B.
Neither House A nor House B have separate dining rooms.

i) House A.
In House A the windows of the living room face west whereas in House B they face south.

j) House A and House B.
In both House A and House B the kitchen windows face north.

SECTION 4

Before listening to the dialogue, the students should carefully study the plans and

sections of the traditional Egyptian house. Point out the section markers for sections A-A and B-B on the ground floor plan. Encourage the students to try and guess what the rooms are used for. As in the listening exercise in Unit 1, students could act out the dialogue and then do Exercise 15 labelling the drawing with the names of the rooms. The answers to the questions in Exercise 16 require some thought and careful reading of the drawings, particularly question *f*). Section A-A shows that the house is one in a row of terraced houses and so there can be no windows in the party walls. The use of pointer words in the dialogue should be discussed and practised in other contexts.

Listening text

CLIENT: I wonder if you could explain these drawings to me, please.

ARCHITECT: Yes, certainly. Where shall we start?

CLIENT: Well, what does the first drawing show? This one here.

ARCHITECT: Ah yes. This drawing shows the ground floor plan of the house.

CLIENT: And this one?

ARCHITECT: The plan of the first floor.

CLIENT: And these?

ARCHITECT: Longitudinal and transverse sections through the house. This is what you would see if you cut the house in half and looked at it from the side.

CLIENT: Oh I see. Now these drawings are beginning to make sense. The entrance to the house must be here but what are these spaces used for on the ground floor?

ARCHITECT: Well, as you go through the entrance, there is a toilet immediately on the right, here. Next to that is the stable with access from the courtyard in the centre of the house.

CLIENT: Ah yes, I see, the courtyard doesn't have a roof. Is that right?

ARCHITECT: Yes, that's quite right: it's an open courtyard. The staircase leads from the courtyard to the first floor. Now look at the plan of the first floor. It shows the open roof terrace and a bedroom.

CLIENT: There's also a bedroom on the ground floor isn't there? I can see a bed shown in the room below the roof terrace. Look. There.

ARCHITECT: Yes, you're quite right. That bedroom is used in the winter and the one on the first floor is used in the summer.

CLIENT: What about the room next to the winter bedroom? This one here.

ARCHITECT: Ah! That's the kitchen. Many people think that is the most important room in the house.

CLIENT: (*laughing*) Yes, food is important, isn't it?

Answers

Exercise 15

a) toilet *b*) stable *c*) courtyard *d*) kitchen *e*) winter bedroom *f*) summer bedroom *g*) open roof terrace

Exercise 16

a) No *b*) Yes *c*) in the south facing wall *d*) mass construction *e*) dome-shaped *f*) because there are houses on either side of the two longest walls

UNIT 3 Structure

Aims

To introduce and practise expressions associated with the description of the structure of buildings and their components.

Main language items

Verbs associated with structure – active: e.g. *consists of, span* – and stative passives: e.g. *be composed of, be made up of*

Defining and naming statements using relative clauses: e.g. *The vertical and horizontal members which are used to make the structure are called posts and lintels respectively.*

Notes

SECTION 1

Exercise 1 presents the three main types of structural systems: *trabeated, arcuated* and *framed*. Other types of structural systems include: *space structures, stressed skin structures* (structures clad with thin elements designed to contribute to the strength of the whole), *shell structures* (thin but extensive curved structural members capable of supporting themselves), and *air supported structures* (structures formed by thin flexible membranes which are supported by air pressure). A useful additional exercise is to try and identify the different types of structural systems used in the buildings illustrated in Unit 7, Exercise 16. The active verbs associated with structure are presented in Exercise 1 and the passive verbs in Exercise 2. Some of the verbs presented have fine distinctions in meaning which are not consistently followed in architectural texts. *Consists of, be constructed from* and *be composed of* are often used interchangeably. However, strictly speaking, *consists of* is the general term when *all* the main parts of a structure are named; *constructed from* and *be made up from* are used when the emphasis is on the process of making something by combining parts; *be made up of* tends to be used when there is a detailed breakdown of a (part of a) structure; *be composed of* is often used where the number of parts is unlimited or when the materials from which the structure is formed are named. Point out the difference between *are made up of* and *are made of* in Exercise 2. Note also that the '*s*' drops out of compound nouns: *loadbearing wall and joists* becomes *a loadbearing wall and joist structure*. Compound nouns are used a great deal in architectural texts and it would be a useful exercise for students to analyse a suitable text to identify them and discuss their meaning, e.g. *thermally insulated sheet steel roof decking*. Make sure that in Exercise 5 the noun compounds are constructed properly. Particularly note the answer to (*c*) which is *waterproof covering of asphalt* and not 'waterproof asphalt covering'. This is because to be waterproof is a property of asphalt.

Some additional vocabulary could be introduced in Exercise 1. In floors the beams are generally called *joists* when of wood; in roofs the girders (very deep beams) are usually called *purlins* and the beams *rafters*. Note also that the word *span* can be used as both a noun and a verb, e.g. *The span of a structure is the horizontal distance between the centres of the posts; the structure spans 5 metres.*

Exercise 7 is a revision of properties from Unit 1. Try to elicit as many properties as possible for each question. Exercise 8 is a chance to compare the structures of the different types of local buildings by classifying their parts under the headings given. It is probably best for students to go out and make sketches of the structures of the buildings first which can then be analysed later in the classroom.

Answers to exercises

Exercise 1

The loadbearing wall and joist structure consists of three brick walls and three wooden joists.
The walls support the joists which carry the floor.
The joists span a distance of 2 metres.
Materials used for loadbearing wall and joist structures include wood and brick.

Exercise 2

The loadbearing wall and joist structure, in the diagram above, is composed of straight members. The vertical and horizontal members which are used to make the structure are called walls and joists respectively. The walls are spaced at 2 metre centres. They are made up of bricks. The bricks are made of burnt clay and the joists are made of stone.

Exercise 3

a) roof beams and floor beams *b*) the floor *c*) two steel stanchions, a roof beam and a floor beam *d*) wedge-shaped bricks *e*) 4 metre centres *f*) tie beams *g*) 3 metres *h*) 1 metre *i*) the keystone *j*) arcuated: brick, stone, mud, concrete; framed: wood, aluminium, steel, reinforced concrete

Exercise 4

a) What does the roof consist of?
What do the walls/floors consist of? etc.

a) The roof consists of a roof structure and a waterproof covering.
The walls consist of a wall structure and cladding.
The floors consist of floor structures and wearing surfaces.
b) The factory is constructed from four elements.
The wall is constructed from two compound units.
The roof is constructed from two compound units.
c) The roof structure is made up of joists and slabs.
The wall structure is made up of beams and stanchions.
The floor structure is made up of panels.
d) The joists are made of wood.

The corrugated sheets are made of steel.
The panels are made of precast concrete.

Exercise 5

a) timber joists *b*) wood-wool slabs *c*) waterproof covering of asphalt *d*) vinyl tiles *e*) precast concrete panels *f*) corrugated steel sheets *g*) steel stanchions *h*) concrete column bases

Exercise 6

is constructed; roof; walls; floor; foundations; consists of; asphalt; roof structure; wood-wool; compound units; steel beams and stanchions; cladding; corrugated steel; floor; vinyl tiles; precast concrete panels; concrete column bases.

Exercise 7

a) Because it has high tensile and compressive strength.
b) Because it is impermeable.
c) Because they are impermeable, light and rigid.
d) Because they are hard-wearing, non-slip, easily cleaned and have an attractive appearance.
e) Because it has high compressive strength, is durable, cheap and can be cast in situ.

SECTION 2

Exercises 9 and 10 present and practise ways of describing different types of joints. Note that the parts of a building can either meet at joints or connections. In the field of building, *joint* refers to the space between components whether or not they are in contact; a connection has the added implication that the components are held together structurally (i.e. so that forces can be transmitted through them).

For more advanced students the following more complete list of verbs associated with the structure of buildings could be presented and definitions looked up in a dictionary:

Parts and the whole

consist of	assemble	be made up of (from)
contain	erect	be constructed from
include	be composed of	be built of

The connection between parts

carry	hold in place	be joined to	be built into
rest on	link	be attached to	be located in
bear on	hang	be connected to	be placed
transmit	adhere	be supported by	be welded to
grout	glue	be fixed to	be riveted to
encase	resist	be secured to	be bolted to
span	act on	be acted upon	be embedded in
distribute	exert	be resisted by	
spread	bind together	be fitted into	
cantilever	fasten together	be installed	

Composition	be encased with	be spaced at
be made of (from)	be laid over	be machined
be built from	be enclosed	be formed in
be divided into	be set within	
be filled with	be surrounded by	
be covered with		

Answers

Exercise 9

a) . . . is joined to . . . bolts.
b) . . . are bolted together.
c) . . . is transmitted through the bolts to plate D.
d) . . . is bolted to . . .
e) . . . because the contact faces of the joint are not machined flat.

Exercise 10

a) Joint A: The *floor* board is nailed to the joist.
B: The aluminium sheets are riveted together.
C: The thin sheets of wood are glued together (to make plywood).
D: The steel channel is welded to the steel column.
E: The steel channel is bolted to the steel column.

b) Joint A: The sideways force on the floor board is transmitted through the nails to the joist.
B: The force on one aluminium sheet is transmitted through the rivets to the other aluminium sheet.
C: The force on one sheet of wood is transmitted through the glue to another sheet of wood.
D: The force on the steel channel is transmitted through the weld to the steel column.
E: The force on the steel channel is transmitted through the bolts to the steel column.

c) Joints A and E.
d) Joints B, D and E.

SECTION 3

Answering some of the questions in Exercise 11 requires careful reading of the drawings. Exercise 12 is a way of summarising the passage using a table. As an extra exercise point out that the first two sentences of the passage can be rewritten in the following way:

The single-storey structure consists of three frames *which* are made up of steel stanchions and beams.

Ask students to find other pairs of sentences where similar changes are possible. They can then rewrite the whole passage making these changes.

Answers

Exercise 11

a) The angles are bolted to connecting plates. The connecting plates are welded to the ends of the roof beams.

b) The loads on a roof beam are transmitted through stanchions to column bases.

c) Mortar.

d) So that the cladding can be placed outside the line of the stanchions.

Exercise 12

Elements	Compound units	Units	Materials
Structure	steel frames tie beams	connecting plate, beam, stanchion, cap plate, base plate, angle	steel
Space dividers	cladding end walls	profiled sheet, bricks	steel burnt clay
Foundations	–	column bases	concrete

Extra exercise

The single-storey structure consists of three frames which are made up of steel stanchions and beams. The frames are placed between end walls and spaced at 3 metre centres. The stanchions carry the beams which support the roof. The roof beams cantilever a short distance beyond the stanchions. This means that they extend over the profiled sheet steel cladding which can then be placed outside the line of the stanchions.

The beams are bolted to steel stanchion caps which are welded to the top of each stanchion. The load on each beam is transmitted through these plates to the stanchions.

The upper face of the steel base plates and the ends of the stanchions are machined flat. The bottom of each stanchion is welded to a base plate which is fixed to a concrete column base by two holding-down bolts.

Steel angles are fixed across the ends of the beams and built into the brick walls. These angles tie the frames together and also provide a place to fix the top of the cladding.

SECTION 4

Exercise 13

This exercise practises the skill of note taking. After students have done the exercise filling in the blanks, they could listen to the passage again without the format presented and try to construct their own notes. Students should then give a summary of the lecture from the notes they have taken.

Listening text

Let's look closely at this drawing of a structure. It's an example of an arcuated structure and it's called a segmental arch. It's given that name because it's shaped like the segment of a circle. Now arcuated structures have one big advantage: they can be used to span openings with components smaller in size than the width of the opening. As you can see, bricks are used as the components for this arch and each one is a lot smaller than the width of the opening. The bricks have been formed into a wedge shape. This is done so that their weight is distributed downwards along the curve of the arch. In this way, the bricks support each other over the opening. When the arch is constructed, the last bricks placed in position are the keybricks. They're located at the top or crown of the arch and they lock the other bricks in position. The joints, here, here, and so on, are between the bricks at right angles to the curve of the arch. They are filled with mortar made of cement and sand. Now mortar is strong in compression but weak in tension. However, all the forces in an arch must be compressive, so that the mortar does not take any tensile forces. An earthquake may move the arch and cause tensile forces in it. If this happened then the arch would fall down. Because of this, I suggest you don't walk under an arch during an earthquake.

Answers

segmental; segment . . . circle; smaller . . . width; wedge; support; keybrick; bricks . . . right angles; cement . . . sand; compressive; fall down.

UNIT A Revision

Aims

To revise the linguistic items in Units 1, 2 and 3. To bring together the concepts of shape, property, location and structure as used in architectural texts to describe buildings.

Notes

The first part of the unit deals with descriptions of two world famous buildings. If possible try and obtain more information about these buildings from architectural texts. Building A is the Pirelli Centre in Milan and Building B is Farnsworth House, Plano, Illinois. To identify which sentence in Exercise 1 refers to which building requires careful examination of the drawings and should lead to a lot of discussion. The sentences could be written up on the board under the two headings as they are identified, then numbered in a logical order and finally combined to make two paragraphs.

As an extra exercise ask students to make sentences comparing these points about the two buildings:

a) number of storeys above ground level
b) number of floors below ground level
c) shape of elevations

d) shape of plans
e) type of structure
f) the properties of the materials used to make the structures

In Exercise 4, the paragraph describes an imaginary building. Students should work in groups to construct the drawings then compare the results.

Answers to exercises

Exercise 1

a) B *b*) A *c*) A *d*) B *e*) A *f*) B *g*) B *h*) A *i*) B *j*) B *k*) B *l*) A *m*) B

Exercise 2

a) tapering column *b*) wall column *c*) loadbearing corner unit *d*) precast concrete panels *e*) roof frame *f*) floor beam *g*) floor frame

Exercise 3

Building A

The building has 30 storeys above ground and 3 basement levels. Its plan is roughly hexagonal in shape. The skeleton structure is made of reinforced concrete. It consists of four triangular-shaped loadbearing corner units and two wall columns between them. Each wall column is made up of four tapering columns with floor slabs spanning between them.

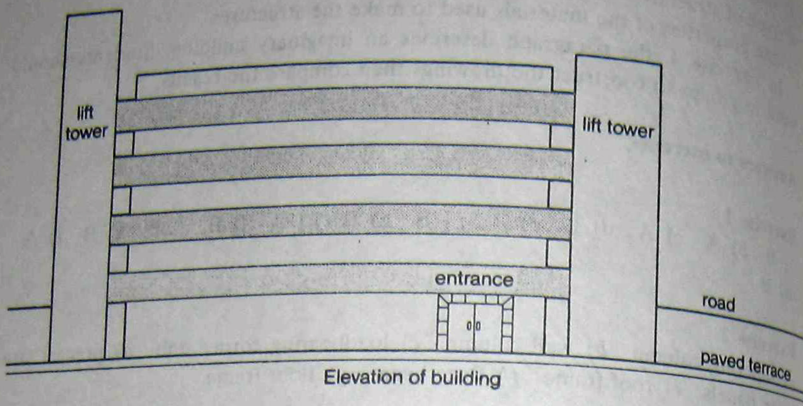
Building B

The building has one storey which is raised above ground level. It has a plan shaped like a rectangle. The skeleton structure is made of welded steel. The roof and floor frames are made up of I-shaped beams and channels. These frames are supported by steel stanchions which are spaced at 7 metre centres. The roof and the floor consist of precast concrete panels which span between the beams.

Extra exercise

a) Building A has 30 storeys above ground level whereas Building B has one.
b) Building A has three basement levels whereas Building B does not have any.
c) Both buildings have rectangular-shaped elevations.
d) Building A has a plan which is roughly hexagonal in shape, on the other hand, Building B has a plan shaped like a rectangle.
e) Both buildings have a skeleton structure. However, Building A's structure is made of reinforced concrete whereas Building B's structure is made of steel.
f) Both steel and reinforced concrete are heavy. Steel is impermeable whereas concrete is permeable. Reinforced concrete is corrosion resistant whereas steel is not. Both materials have high tensile and compressive strength. *etc.*

Exercise 4



Elevation of building

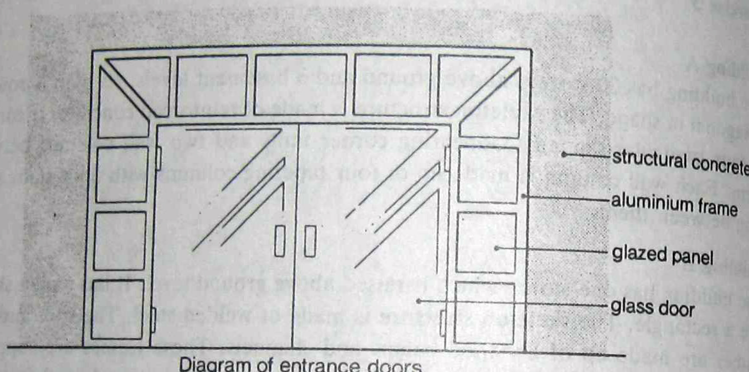


Diagram of entrance doors

UNIT 4 Measurement 1

Aims

To introduce and practise language items associated with measurement and units commonly used in building: the notion of variation in quantity and range: human measurements and their effect on designing buildings: specifying performance requirements.

Main language items

Verbalisation of units of measurement: e.g. *kg/m³ – kilogrammes per cubic metre*

Statements of measurements: e.g. *The volume of the room is 60 cubic metres. The room has a cross-sectional area of 12 square metres. The temperature of the room is measured in . . .*

Expressions of variation and change: *varies between . . . and; ranges from . . . to*

Extremes and average: *maximum; minimum; average*

Expressions used in specifications: *the area of the room should be/should not be greater than/should not be less than*

Notes

SECTION 1

This section is concerned with the relationship between the measurements of the dimensions of space and the measurements of the dimensions of people. Exercise 1 introduces the distinction between linear dimensions like length, square dimensions (area) and cubic dimensions (volume). Compare the statements of measurement used here with the statements of property introduced in Unit 1 (e.g. *The minaret is pencil-shaped . . .; . . . the building has five external surfaces*).

In Exercise 2 students estimate the measurements of the dimensions of buildings. Use tape measures if they are available, otherwise pace out the dimensions. Groups of students could be given the tasks of measuring different rooms and then the tables of information presented and compared.

In Exercise 3 students will find it difficult to get exact measurements because of the shape of the human body. Discuss what the size of the group measured should be if these figures were to be used for the designing of furniture for a) their school b) their town c) their country.

The statement at the beginning of Exercise 4 is not strictly true. Architects do not consider the maximum, minimum and average dimensions of people. They use values for each characteristic which are called 95th percentile, 5th percentile and 50th percentile. The 95th percentile is the position at or below which measures for 95 per cent of the total population are found. It is not always economic or practicable to cover 100 per cent of the population by catering for people at the extremes, and attempts to do so can compromise the convenience of solutions for the broad range of normal people. However, to avoid introducing too great a load of statistical terminology it is probably better to stick with using the terms maximum and minimum. Exercise 7 gives free reign to the imagination of the students. Criticism of the dimensions of the furniture they use everyday could be included here.

Answers to exercises

Exercise 1

What is the volume of the room?
The volume of the room is 60 cubic metres.

What is the longitudinal-sectional area of the room?
The longitudinal-sectional area is 15 square metres.

What is the cross-sectional area of the room?
The cross-sectional area is 12 square metres.

What is the internal surface area of the east facing wall?
The internal surface area of the east facing wall is 13 square metres.
etc.

The room has a volume of 60 cubic metres.
The room has a longitudinal-sectional area of 15 square metres.
The room has a cross-sectional area of 12 square metres.
The east facing wall has an internal area of 13 square metres.

etc.

Exercise 4

a) widest person *b*) average length of lower leg *c*) average eye height
d) shortest length of upper leg *e*) average forward reach

Exercise 6

a) Because children are smaller than adults.
b) Because people wear thicker clothing in winter.
c) Because the average height of an African is greater than a Japanese.
d) Because it is too expensive to design doorways high enough for the very few people in Britain that are taller than 2 100 mm.

SECTION 2

Exercise 8 deals with the common units used in architecture. SI units are now used by most countries except the U.S.A. which still uses Imperial Units. SI Units or 'Système International d'Unités' was finalised in 1960 and is based on the original metric system of measures. Students should first try and match the dimensions with the units listed. Ensure that they learn the abbreviations and how to verbalise them by writing items like 30 dB, 10 kg/m³ on the blackboard and asking them to read them out aloud; and by dictating the full forms for students to write as abbreviations.

Exercise 9 uses a passive construction to reinforce these terms. In Exercise 10, students can transfer ideas from the diagram in Exercise 9 to the classroom, e.g. the noise level of the cassette recorder is measured in decibels, etc. Note that the unit 'joule' is a unit of work, energy and quantity of heat. For further information about the units used in architecture, students should consult the *A J Metric Handbook*.

Exercise 11 introduces the expressions used in specifications where the architect lists the performance standards he requires the builder to achieve. Students may require some help with working out the equations to solve the three problems:

a) Area required = 5 persons × 10 square metres
= 50 square metres

b) Force = Stress × Area

$\therefore$ (therefore) Area = $\dfrac{\text{Force}}{\text{Stress}}$

$$\text{Area} \nless \frac{2\,000 \text{ N}}{5 \text{ N/mm}^2}$$

$$\text{Area} \nless 400 \text{ mm}^2$$

($\nless$ means 'not less than')

c) Density $= \dfrac{\text{Weight}}{\text{Volume}}$

Density $\ngtr \dfrac{22\ 000\ \text{kg}}{10\ \text{m}^3}$

Density $\ngtr 2\ 200\ \text{kg/m}^3$

($\ngtr$ means 'not greater than')

After doing these problems, the students could write out their own list of performance requirements for, say, a house. They should be encouraged to talk about the limits of these requirements, e.g. the area of the lounge should not be less than 15 square metres or greater than 25 square metres.

Answers

Exercise 8

a) Mass is measured in kilogrammes.
b) Density is measured in kilogrammes per cubic metre.
c) Noise level is measured in decibels.
d) Stress is measured in newtons per square millimetre.
e) Illumination is measured in lux.
f) Luminous flux is measured in lumens.
g) Electric current is measured in amperes.
h) Temperature is measured in degrees Celsius.
i) Heat is measured in joules.

Exercise 9

a) degrees Celsius *b*) stress *c*) decibels *d*) lux *e*) density *f*) amperes *g*) illumination *h*) watts

Exercise 11

a) 5; 10 square metres; the area of the room should be 50 square metres.
b) 2 000 newtons; maximum compressive stress; 5 N/mm²; the cross-sectional area of the column should not be less than 400 mm².
c) *The volume* of the wall is 10 cubic metres. The maximum weight of wall allowed is 22 000 kilogrammes. Therefore the density of the concrete should not be greater than 2 200 kg/m³.

SECTION 3

The reading passage is an example of the sort of text found in building regulations. In this case it is about the maximum size of aggregate which can be used in reinforced concrete. Some of the true/false statements require detailed examination of the text and they should lead to discussion about the deductions made. Exercise 12 is designed to stimulate discussion about the building regulations for reinforced concrete. The discussion could be extended to other areas such as the size of rooms, fire regulations and the need for them.

Answers

Exercise 12

a) False. Concrete is made from four different materials.
b) False. Coarse aggregate ranges in size from 5 mm to 40 mm.
c) True.
d) True.
e) False. Cover is the thickness of concrete covering the reinforcing rods.
f) True
g) False. Spalling can occur in a solid concrete slab when the maximum size of the coarse aggregate is greater than the cover to the reinforcement.
h) False. When the minimum horizontal distance between reinforcing rods is 15 mm, the maximum size of the aggregate should be 10 mm.

Exercise 13

a) 30 mm *b*) 25 mm *c*) 15 mm *d*) 30 mm

SECTION 4

The listening exercise is mainly an exercise in reading a drawing and listening to someone refer to the dimensions of a building indicated on it. The drawings are best examined first and then the text listened to with notes being taken on the second reading. The idea of scale is introduced here for the first time and it should be discussed so that students understand the concept. In Exercise 15, students are asked to take measurements from the drawings.

Listening text

1ST WORKMAN: Right, we've finished measuring the dimensions of the building, let's check the measurements with the drawings to see if they agree.

2ND WORKMAN: O.K. You read out the measurements and I'll check them on the drawings.

1ST WORKMAN: Are you ready?

2ND WORKMAN: Yes.

1ST WORKMAN: O.K. The external length of the building is 12 500 mm.

2ND WORKMAN: That's right.

1ST WORKMAN: And the external width is 7 550 mm.

2ND WORKMAN: That's O.K. too. What about the height?

1ST WORKMAN: Hold on a minute. Ah yes. The height from ground level to the top of the parapet is 7 950 mm.

2ND WORKMAN: Good. Those measurements agree alright. Let's check the internal ones now.

1ST WORKMAN: Right. Oh. Which room first?

2ND WORKMAN: Let's start with the entrance hall.

1ST WORKMAN: O.K. That room is square with a side of 2 200 mm.

2ND WORKMAN: Yes. That's good. Now the living room.

1ST WORKMAN: That's 4 800 mm by 3 800 mm.

2ND WORKMAN: Yes. And the kitchen/dining room?

1ST WORKMAN: 4 500 by 4 000 mm.

2ND WORKMAN: Wait a minute! Are you sure we measured it to be 4 500 mm long? It should be 4 800 mm because it's the same length as the living room.

1ST WORKMAN: Sorry. I can't read my own writing. You're right it's 4 800 mm by 4 000 mm.

2ND WORKMAN: And the first bedroom?

1ST WORKMAN: 4 000 by 3 150.

2ND WORKMAN: And the second bedroom?

1ST WORKMAN: 3 250 by 2 250.

2ND WORKMAN: And the bathroom?

1ST WORKMAN: 2 130 by 1 220 mm.

2ND WORKMAN: So far so good – now some heights. What is the floor-to-ceiling height?

1ST WORKMAN: Ah. Now. The floor-to-ceiling height for all rooms except the bathroom and toilet is 3 000 mm. The ceilings in the bathroom and toilet are 900 mm lower.

2ND WORKMAN: Umm . . . 900 from 3 000 that's . . .

1ST WORKMAN: 2 100.

2ND WORKMAN: That's right. Good. Carry on.

1ST WORKMAN: Well. In each room the windowsill height is 900 mm and the window head height is 2 100 mm above the floor.

2ND WORKMAN: That's great. All the measurements agree thank goodness. Let's go and have a cup of tea.

1ST WORKMAN: Wait a minute! You've got the wrong drawings there haven't you?

2ND WORKMAN: Don't be silly they're the right ones . . .

1ST WORKMAN: No, they're not . . . .

Answers

Exercise 14

a) 12 500 mm *b*) 7 550 mm *c*) 7 950 mm *d*) 2 200 mm *e*) 3 800 mm
f) 4 000 mm *g*) 4 000 mm *h*) 2 250 mm *i*) 1 220 mm *j*) 2 100 mm
k) 3 000 mm *l*) 2 100 mm *m*) 900 mm

UNIT 5 **Process 1 Function and Ability**

Aims

To present and practise ways of describing different building types; their functions and capacities; the design requirements performed by elements of the building enclosure; the suitability of material for these requirements; functions in heating and air-conditioning systems.

Main language items

the function of: e.g. *What is the function of a university?*

functions and serves: e.g. *A university functions/serves as a place for educating students.*

used for: e.g. *The lecture room is used for giving lectures.*

provide: e.g. *Spaces provided in the building include a lecture room, laboratories and a library.*

serves the function of: e.g. *The lowest floor serves the function of modifying the passage of heat.*

act as: e.g. *The external wall acts as a thermal insulator.*

is designed to: e.g. *The roof is designed to resist loads.*

enable to: e.g. *The partition enables the building to provide visual screening.*

has the capacity to/is capable of: e.g. *The university has the capacity to educate/is capable of educating 200 students a year.*

has the ability to/is able to/is capable of: e.g. *An impervious material has the ability to keep out/is able to keep out/is capable of keeping out water.*

Notes

SECTION 1

Exercise 1 introduces the idea that the names of different building types indicate their overall function, e.g. a hotel is a place for accommodating people. Before starting the exercise try to elicit from the students a list of all the building types they know. Then do the first part of Exercise 1 and add any they may have missed. Next, see if the students can work out a classification system for building types. Then build up on the board a chart of general building types plus examples. An example of the sort of chart that may be built up is shown below:

Residential	Education	Religion	Recreation
block of flats maisonettes terraced houses hotel bungalow	school library university	church mosque cathedral	swimming pool cinema theatre restaurant
Welfare	**Transport and industry**		**Administration and commerce**
old people's home hospital fire station	warehouse bicycle factory railway station bus station		bank post office department store

Finally ask and get students to answer questions like these:

T: What is a hotel used for?

S1: A hotel is used for accommodating people.

T: What types of activities happen in a hotel?

S2: Sleeping, eating, drinking, meeting, *etc.*

Exercise 2 is about the spaces in a building and the activities that go on in those spaces.

After completing this exercise look at a map of a town and discuss where different building types are grouped and located.

Many factors determine the location of buildings within a town or city. Public administration buildings, large shops and entertainment centres are usually located in the centre so that they are easily accessible to most people. Recreational areas are needed both in the centre and in the suburban districts. Industrial buildings tend to be grouped together on the outskirts of a town because of noise, traffic and pollution. However, many modern industries such as the electronics industry tend to be pollution free so they could be located in residential areas.

Note that in Exercise 3, questions b) and c) each follow the answer to the previous question.

Also note the use of the definite article in the answers produced in Exercise 4. It is much more difficult to generalise in architecture than in the sciences, so it is *The house . . .* and *The factory . . .* rather than *A house . . .* or *A factory* (*has the capacity to make 400 precast panels per week.*)

Answers to exercises

Exercise 2

a) preparing experiments *b*) library *c*) eating food *d*) sleeping *e*) kitchen *f*) treating patients *g*) giving out drugs *h*) examination room *i*) mixing concrete *j*) store, warehouse *k*) casting space

Exercise 3

What is the function of a house?
A house functions as a place for accommodating people.
What spaces are provided in a house?
Spaces provided in a house include a kitchen, a dining room and a bedroom.
What is a kitchen used for?
A kitchen is used for preparing and cooking food. *etc.*

The dialogues can be abbreviated and extended to sound more natural as in the following example:

What's the function of this factory?
It serves as a place for making precast concrete panels.
What spaces are provided there?
A store, a mixing space and a casting space.
What's the store used for?
Storing materials such as cement, gravel and sand.

Exercise 4

The house is capable of accommodating a family of five persons.
The hospital has the capacity to treat up to 150 patients per day.
The factory has the capacity to make 400 precast panels per week.
The post office has the capacity to handle up to 1 000 letters per day.
The shop is capable of serving up to 200 customers per day.
The railway station is capable of dealing with 10 train movements per day.

SECTION 2

A building is designed for a specific purpose and it is this purpose which defines the overall function of the building. In Section 1 the functions of buildings have been discussed. Now the various elements of a building have to be put together in such a way as to achieve that overall function.

To a certain extent the functions of the various elements of a building can be generalised, but usually these will be related to the overall function of the building. Exercise 5 introduces eleven different functions of building elements. The student has to allocate the most important functions to the six major building elements. This should lead to a lot of discussion as the answers really depend on the overall function of the building and to such things as building regulations. However, the diagram indicates what are thought to be the most important functions of each element. So it is suggested that you start the exercise by looking at the diagram and identifying the different functions illustrated. This activity can be extended to discussion about the functions of the building elements around you (assuming you are indoors).

Exercise 7 relates properties of materials to the function of building elements. So for a building to be capable of keeping out water it must be made of an impervious material. Ultimately the choice of materials and how they are used depends on the overall function of the building.

Answers

Exercise 5

lowest floor	C,H,J	suspended floor	C,F
external wall	A,B,D,F,G,H,J,K	partitions	B,E,I
roof	A,F,H	suspended ceiling	E,I,K

Exercise 6

a) The roof enables the occupants of a building to keep dry.
The partitions enable the occupants to have privacy.
The roof and external walls enable them to keep warm.
The partitions, suspended floor and ceiling enable them to be safe from fire.
The lights in a suspended ceiling enable them to read during the night time.
The external walls enable them to be safe from intruders.

b) The partition is designed to control the noise level between rooms.
The roof is designed to support snow loads.
The lowest floor is designed to resist the passage of moisture.
The external walls are designed to let in natural light.
The external walls are designed to control the movement of people into and out of the building.

c) The lowest floor, external wall and roof act as a thermal insulator.
The suspended floor, partitions and suspended ceiling act as a sound insulator.
The partitions act as a space divider.
The external envelope acts as a filter to separate the internal volume from the external environment.
The external wall and lowest floor act as a moisture barrier.

Exercise 7

Concrete is unable to keep out water.

Aluminium has the ability to resist attack by corrosive substances.

Steel is able to conduct heat.

Steel is capable of withstanding a compressive force without breaking.

Mineral wool is not capable of withstanding a high tensile force without breaking.

Mineral wool does not have the ability to conduct heat.

Ceramic tile is capable of withstanding scratching from another body.

Exercise 8

a) steel *b*) aluminium *c*) mineral wool *d*) concrete *e*) concrete *f*) ceramic tile

Steel has high tensile and compressive strength and is therefore used to provide a structure for a building.

Aluminium has good weather resistance and is therefore used to provide a weather resisting surface for a wall.

Mineral wool has low thermal conductivity and is therefore used to provide thermal insulation for a wall.

Ceramic tiles have a good appearance and are therefore used to provide an attractive finish for a wall.

Exercise 9

Lowest floor:

One suitable material is *concrete*, because concrete has high compressive strength and fairly low thermal conductivity. It is, however, pervious, so a layer of impervious material such as polythene should be included when the floor is laid.

External wall:

One suitable material is *brick*, because bricks are weather resistant and can resist loads.

Roof:

One suitable material is *aluminium*, because it is weather resistant. However, it needs a structure to support it and the addition of insulating material.

Suspended floor:

One suitable material is *timber*, because it provides a good surface for activities. However, its sound insulation properties are not good, so additional material will be needed to control sound transmission.

Partitions:

One suitable material is *brick*, because the fire resistance and sound insulation properties of brick are good.

Suspended ceiling:

One suitable material is *plaster board*, because its fire resistance properties are good. It can also have good sound insulation properties.

SECTION 3

The reading passage describes one method of heating a building by the circulation of hot water through radiators. Before starting the reading passage discuss other possible methods by comparing the advantages of central heating systems with individual heating systems for each room. Discuss also the different types of fuel used and the different geographical locations and situations where heating is necessary.

Answers

Exercise 10

a) burner *b)* expansion tank *c)* safety valve *d)* aquastat *e)* radiator *f)* thermostat *g)* pump

Exercise 11

a) A heating system enables the inside of a building to be kept warm.

b) The pump circulates hot water through the continuous pipe.

c) The thermostat acts as the room temperature controller.

d) The aquastat functions as a means of controlling the temperature of the water in the boiler.

e) The radiator is designed to transfer the heat from the hot water to the air in the room.

f) The safety valve prevents the boiler from blowing up.

g) The burner serves as a device for heating the water in the boiler.

h) The expansion tank enables the water to expand safely.

Exercise 12

a) When the pump is switched on, hot water flows through the pipe to the radiators.

b) When the temperature of the water in the boiler decreases, the aquastat starts up the burner.

c) When the temperature of the water in the boiler reaches the set temperature, the aquastat shuts down the burner.

d) When the air temperature decreases, the thermostat switches on the burner.

e) When the radiator is turned on, heat is transferred from the hot water to the air in the room.

f) When the water in the boiler expands, it flows into the expansion tank.

g) When the boiler pressure is too high, the safety valve relieves the pressure.

Exercise 13

In a commercial office, the three most important functions of an air conditioner are to remove odour, to clean the air and to move the air.

In an apartment, the three most important functions of an air conditioner are to control temperature, to remove odour and to control noise.

In a school classroom, the three most important functions of an air conditioner are to control temperature, remove odour and to treat the air for germs.

In a motel, the three most important functions of an air conditioner are to control temperature, to control noise and to remove odour.

SECTION 4

There are many similarities in the way an air conditioner works to the way a refrigerator works. Before you start this section, do the refrigerator exercise in Nucleus General Science Unit 6, Exercise 8. Then, if possible, have a look at a real air conditioner and discuss the names of its parts and how they function. If that is not possible, then discuss the function of all the parts of an air conditioner listed in Exercise 14. Note that students must be familiar with the reading passage to be able to answer some of the questions in this section.

Listening text

LECTURER: Here we have what's called a 'packaged air conditioning unit'. It's called that because it contains all its parts in one unit. Now I've removed the front of the cabinet so you can see inside. Notice that it is located on an outside wall so that fresh air can be drawn in here. O.K. Can you all see? The air then passes through these aluminium air filters . . .

STUDENT: What is the function of the air filters?

LECTURER: Umm . . . Well it does what it says – it filters the air removing the dust so . . .

STUDENT: So that's why it's dirty.

LECTURER: Err . . . Yes, but you are able to remove the filters for cleaning. In fact this one should be cleaned as soon as possible. Err. Aahem. Yes, then the air passes through the evaporator and . . .

STUDENT: What does that do?

LECTURER: Err . . . Well. That serves the function of cooling the air. You see, a gas is circulated through the condenser here. That's a cooling device which turns the gas into a liquid. It then passes through a valve into the evaporator here where . . .

STUDENT: Where the liquid evaporates.

LECTURER: Err . . . Yes, that's right. The liquid expands into a gas and absorbs heat from the evaporator which . . .

STUDENT: Absorbs heat from the air.

LECTURER: Yes. Now keep quiet will you and don't touch that.

STUDENT: What is the evaporator made up of?

LECTURER: Oh. The evaporator consists of cooling coils made of copper with aluminium fins. They are designed to absorb the maximum amount of heat. The cool clean air is now forced into the room through the adjustable louvre by . . .

STUDENT: A fan.

LECTURER: Yes, the fan here. I'll switch it on now so you can see how it works. Stand back. Now look. I told you not to touch that . . . (BANG)

Answers

Exercise 14

A. The four-way adjustable louvre is located at the top of the unit. It serves the function of directing the air conditioned air into the room. It is adjustable in four directions: up and down, and to the left and right.

B. The thermostat control and OFF-AIR-COOL switch are located just below the four-way adjustable louvre. The thermostat control acts as the room temperature controller. The OFF-AIR-COOL switch operates either the whole air conditioning unit or just its fan.

C. The adjustable speed fan is located below the control knob. The function of the fan is to force the cool clean air into the room.

D. The fan motor is located to the left of the fan. It serves the function of turning the fan.

E. The evaporator is located just above the air filters in the centre of the unit. It is designed to absorb heat from the air.

F. The air filters are located in the centre of the unit. They act as filters removing dust from the air.

G. The fresh air opening is located at the back of the unit below the air filters. The function of this opening is to allow fresh air to be drawn into the room.

H. The condenser is located on the bottom right-hand side of the unit. Its function is to turn the refrigerant gas into a liquid.

I. The compressor is located to the right of the condenser. It serves the function of compressing the gas.

Exercise 15

a) Because it contains all its parts in one unit.
b) So that fresh air can be drawn in.
c) They are made of aluminium.
d) As soon as possible.
e) Copper and aluminium.
f) To absorb the maximum amount of heat.

UNIT 6 Process 2 Actions in Sequence

Aim

To present and practise ways of describing the assembly sequence of prefabricated buildings; the sequence of work on a building site; the work stages for architect, contractor and client; the phases of cost control.

Main language items

Markers of time sequence: *first, initially, then, later, subsequently, finally*

Reduced time clauses: e.g. *Before fixing the horizontal cladding panels, the workmen erect the corner units.*

Time clauses with: *before, after, as, when, until, as soon as, immediately after, simultaneously with, at the same time as, from the beginning of . . . to the end of . . ., this precedes, this is followed by*

Former and latter: e.g. *While the former erect the steelwork, the latter build the brickwork.*

Notes

SECTION 1

The whole of this section is concerned with the assembly sequence of a prefabricated building. The assembly sequence has been divided into four stages or phases which could correspond to four working days or to the delivery of the components to the site. The components must be assembled in a certain sequence and this sequence has to be discovered by looking at the diagrams. However, to begin with, the teacher should introduce the diagrams of the four phases and go through the vocabulary. Then the markers of time sequence should be introduced. Students should then work in groups to try and work out the sequence of activities for the three remaining phases. A list of reasons why certain actions should take place before others is contained in Exercise 2. However, in certain circumstances the assembly sequence can be arranged in several different ways or new reasons can be discovered. This should prompt some discussion. Some sort of model made out of balsa wood or card would be of great value here.

Answers to exercises

Exercise 1

Phase 2

First, the beams and bracing are fixed.
Then, the concrete floor slabs are put in place.
Later, the upper floor steel columns are erected.
Finally, the roof decks are put in place.

Phase 3

Initially, the corner units are erected.
Then, the horizontal cladding panels are fixed.
Later, the vertical cladding panels are fixed.
Subsequently, the balustrade fixing plates are fixed.
Finally, the weatherproof roof membrane is laid.

Phase 4

Initially, services are installed in the ceiling void.
Then, the partitions are erected.
Later, the suspended ceilings are fixed.
Subsequently, the building is decorated.
Finally, the floor finishes are laid.

Exercise 2

a) Why is the ground excavated before the concrete foundations have been constructed?

b) Why are the column base plates fixed after the concrete foundations have been constructed?

c) Why are the column base plates fixed before the steel columns are erected?

d) Why are the concrete floors put in place after the beams have been fixed?

e) Why are the balustrade fixing plates fixed before the weatherproof roof mem-

brane has been laid?

f) Why are the horizontal cladding panels fixed after the corner units have been erected?

g) Why are the horizontal cladding panels fixed before the vertical cladding panels have been fixed?

h) Why are the services installed in the ceiling void before the suspended ceiling has been fixed?

i) Why are the partitions fixed after the suspended ceilings have been erected?

Exercise 3

a) roof decking *b*) horizontal cladding panels *c*) phase 2 *d*) column base plate *e*) phase 4 *f*) weatherproof roof membrane

Exercise 4

Phase 2

Having completed phase 1, the workmen begin phase 2. This includes fixing the beams and bracing, putting the concrete floors in place, erecting the upper floor steel columns and putting the roof decks in place. The workmen begin by fixing the beams and bracing. This precedes the placing of the concrete floors because they require beams to support them. This is followed by the erecting of the upper floor steel columns. Finally, the roof decks are put in place.

Phase 3

Having completed phase 2, the workmen begin phase 3. This includes erecting the corner units, fixing the horizontal cladding panels, fixing the vertical cladding panels, fixing the balustrade fixing plates and laying the weatherproof roof membrane. The workmen begin by erecting the corner units. This precedes the fixing of the horizontal cladding panels because they are fixed to the corner units. This is followed by the fixing of the vertical cladding panels. Finally, the balustrade fixing plates are fixed and the weatherproof roof membrane is laid.

Phase 4

Having completed phase 3, the workmen begin phase 4. This includes erecting the partitions, installing the services in the ceiling void, fixing the suspended ceilings, decorating the building and laying the floor finishes. The workmen begin by installing the services in the ceiling void. This precedes the erecting of the partitions because the workmen require access to the ceiling void. This is followed by the fixing of the suspended ceilings. Finally, the building is decorated and the floor finishes are laid.

SECTION 2

Many trades are involved in the construction of a building. They cannot all work on the building at the same time because some jobs cannot start until others have been completed. Consequently, the timetabling of jobs is extremely important if the building is to be completed on schedule. Usually the sequence of events in a building programme are shown on a bar chart, although for large building contracts the critical path analysis method is required. This is a technique for determining the most efficient way in which events can be timetabled. In Exercise 5 begin by looking at the

bar chart and asking questions such as:

When do the machine drivers start excavating?

What week do the bricklayers finish?

How long are the joiners on site?

Then introduce the new language items:

During what weeks do the steel workers work?

Do the steel workers work *from the beginning of* week 13 to the end of week 15?

What happens *as soon as* the steel erectors have finished?

What happens *immediately after* the bricklayers have finished?

etc.

Then introduce the adjectives *former* and *latter* and point out that they are to be used only in writing.

The drawings after the bar chart in Exercise 5 are meant to stimulate discussion about what trade is depicted. After the students have completed the slots for trade, job and weeks working for each drawing, they should write out the paragraphs following the model.

Answers

Exercise 5

a) During weeks 22 to 30 the plumbers work simultaneously with the roofing contractor. While the former install the pipework and sanitary fittings, the latter lay the roof covering. As soon as the plumbers have finished, the carpenters begin.

b) From the beginning of week 35 to the end of week 40 the heating contractor works at the same time as the glaziers. While the former puts in the heating installation, the latter put in the glazing. As soon as the glaziers have finished, the decorators begin.

c) From the beginning of week 1 to the end of week 8 the labourers work at the same time as the machine drivers. While the former do the manual work, the latter excavate the ground. As soon as the machine drivers have finished, the steel erectors begin.

d) During weeks 26 to 40 the heating contractor works simultaneously with the electricians. While the former installs the heating equipment, the latter install the electrical equipment. Four weeks after the electricians have finished, the decorators begin.

Exercise 6

While the pipework and sanitary fittings are being installed, some of the doors, windows and screens are manufactured.

While the roof covering is being laid, some of the cladding is fixed.

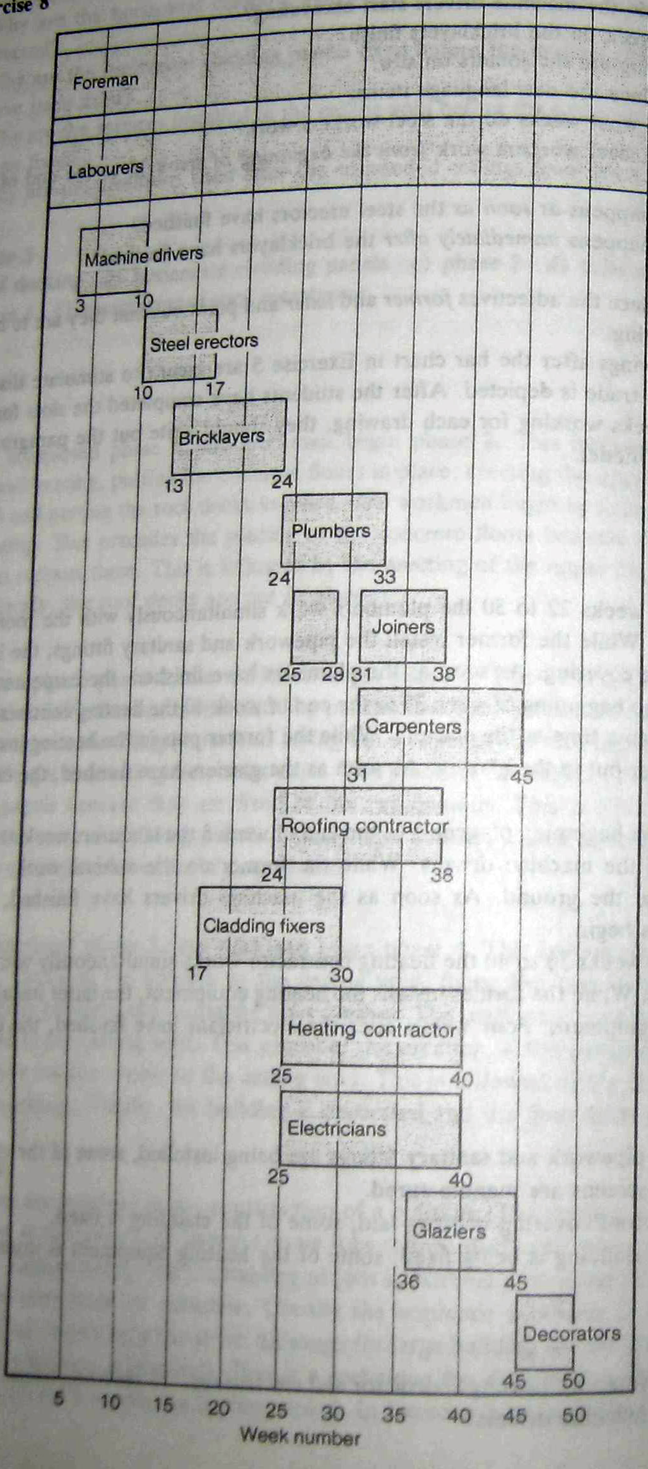
While the cladding is being fixed, some of the heating equipment is installed.

etc.

Exercise 7

a) bricklayers *b*) heating contractor and electricians *c*) cladding fixers *d*) decorators *e*) machine drivers

Exercise 8


Foreman
Labourers
Machine drivers
3
10
Steel erectors
10
17
Bricklayers
13
24
Plumbers
24
33
Joiners
25
29
31
38
Carpenters
31
45
Roofing contractor
24
38
Cladding fixers
17
30
Heating contractor
25
40
Electricians
25
40
Glaziers
36
45
Decorators
45
50
5
10
15
20
25
30
35
40
45
50
Week number

SECTION 3

The reading passage introduces one possible organisational relationship between the client, architect and contractor. In a medium or large contract in Britain a quantity surveyor would also be involved. He is a person responsible for calculating the quantities of materials and amount of labour needed to complete a contract and for estimating their cost. Architects and quantity surveyors are professional people belonging to an institution which has established rules of conduct for its members. This system arose to protect the client's interests by exercising independent control over the contractor. However, Design and Construct Companies are now common in many parts of the world. In these companies the architectural, quantity surveying and contracting functions are all done by one company. Several other different types of organisational relationships between client, designers and builders are possible. For the more advanced students the relative merits of the different systems could be discussed.

Answers

Exercise 10

a) receive a commission *b*) submit *c*) incorporate *d*) bid *e*) make periodic inspections *f*) specified *g*) defects liability period *h*) full possession

Exercise 11

a) receives a commission *b*) commission *c*) the site *d*) preliminary plans *e*) preliminary plans and rough estimates of the cost *f*) if client suggests changes, he incorporates *g*) contractor *h*) draw up a contract with a contractor *i*) client *j*) contractor *k*) the building *l*) bills *m*) bills *n*) periodic inspections *o*) completes *p*) occupies *q*) defects liability period *r*) takes full possession

Exercise 12

Client

Initially, the client appoints an architect. Then, he gives the architect his commission. Later, he approves the preliminary plans and rough estimates of the cost, or he may suggest changes. After approval of the plans, he chooses a contractor and signs a contract with him. The client pays all the bills from the contractor and subsequently occupies the building. Finally, he takes full possession of the building after the defects liability period.

Contractor

First, the contractor submits his tender. If his tender is approved, he signs a contract with the client and starts work on the building. Periodically, he submits his bills to the client. Subsequently, he completes the building. During the defects liability period, the contractor corrects any defects in the building.

Architect

Initially, the architect receives a commission for a building. Then, he visits the site and draws up preliminary plans which he submits to the client. If the client suggests changes he incorporates them into the final design. After this, he assists his client

in selecting a contractor and helps him draw up a contract. Subsequently, he makes periodic inspections as building work progresses. Finally, he makes sure that the building is completed according to the contract.

SECTION 4

Before listening to the passage, the following terms should be introduced: *continuous process, cost control, pre-tender stage, post-tender stage, cost limit, cost target, prices each item in a specification, to file away.*

The introduction of these terms can be done by going over again the sequence of events in a building contract and talking about costing. After this introduction, the students should listen to the passage. During the second reading the students should complete the blanks in the incomplete notes shown in Exercise 13. Exercise 14 should be done orally with students reading back from the notes they took in Exercise 13 and inserting markers of time sequence.

Listening text

INTERVIEWER: At what stage in the design and construction of a building do you apply cost control?

ARCHITECT: Well, we actually apply it at all stages, because cost control should be a continuous process throughout the complete programme of a contract. But it usually occurs in two phases. Firstly during the design or pre-tender stage, and secondly during the actual construction operations or post-tender stage as it is also known.

INTERVIEWER: I should think a client wants to know at a very early stage how much a building will cost him, doesn't he?

ARCHITECT: Oh yes, of course. You see, an architect will usually give him an approximate estimate when he submits his preliminary plans. This then enables the client to set a cost limit above which he is not prepared to go.

INTERVIEWER: So the first step is to set a cost limit. Umm . . . What happens after that?

ARCHITECT: Well, err . . . the cost limit is broken down into cost targets for various parts of the building. Using this you can make sure that you don't spend too much on only a small part of the building. After agreeing the cost targets, the architect completes the final design of the building and the specifications.

INTERVIEWER: Could you explain what specifications are?

ARCHITECT: Oh. Yes, certainly. Well, these are a list of items which describe the work to be done in a building contract. When the specifications have been completed, they are sent to a contractor who prices each item and then submits a tender.

INTERVIEWER: Does that complete phase 1 of the cost control process?

ARCHITECT: Yes it does, but then we go on to the second phase. You see, regular checks must be made during the construction process to compare the estimated cost with the actual cost of construction. You try and finish the building with a cost as close as possible to the tender figure.

INTERVIEWER: I expect you usually spend more than you estimated. Is that true?

ARCHITECT: Err . . . Well, unfortunately, yes, it is true. However, all this information we have collected about costs during the construction of a building is filed away and it is a great help in estimating the cost of a similar building when it is in the pre-tender stage.

INTERVIEWER: Thank you very much for talking to us. That was most interesting.

Answers

Exercise 13

a) pre-tender; preliminary plans; cost limit; cost targets; final design; specifications; contractor

b) post-tender; estimated cost; actual cost; production; in estimating the cost of a similar building in the pre-tender stage

Exercise 14

First, the architect submits his preliminary plans and the client sets a cost limit. Then, the architect completes the final design and specifications. After this, the specifications are sent to the contractor. During the construction of the building, regular checks are made to compare the estimated cost with the actual cost of construction. Finally, all information is filed away to help in estimating the cost of a similar building in the pre-tender stage.

Exercise 15

a) Because it should be a continuous process.

b) When he submits his preliminary plans.

c) Cost targets for various parts of the building. To make sure you do not spend too much on only a small part of the building.

d) Specifications are a list of items which describe the work to be done on a building contract.

e) The contractor.

f) To try and finish the building with a cost as close as possible to the tender figure.

g) To file away all information collected about costs during the construction of a building. To help in estimating the cost of a similar building when it is in the pre-tender stage.

UNIT B Revision

Aims

To extend the description of a prefabricated building to include location, measurement, functions and processes, and to revise patterns and vocabulary from Units 4, 5 and 6.

Notes

There is considerable scope for discussion in the diagram in Exercise 1. After going through the labels on the drawing, the teacher should divide the class into small

groups so they can discuss what actions need to be taken before others and why that is so. The sequence of events is not as obvious as in the first exercise of Unit 6, as several steps in the erection procedure can be carried out simultaneously. While it is expensive to manufacture the components of a prefabricated building, money is saved on the speed with which it can be erected on site and on labour costs. Again, a model would be helpful to discover the best sequence of events to erect the building. The exercise could be extended to include such events as the excavation of the foundations and the decoration of the building.

Exercise 2 can be done with the students in pairs asking and answering questions about the dimensions of the building. The exercise can be considerably extended if a model of the building is constructed.

Note that the diagram in Exercise 3 is an enlarged section through the wall of the building shown in Exercise 1.

Exercise 4 may be too difficult for some classes. This exercise could be done as a slot filling exercise on the board with all the technical terms left out.

Exercise 5 introduces the functions of language for the first time. It should be pointed out that there are several possible ways of completing the sentences.

In Exercise 6*a*), the students should discuss the fact that the building has been designed for speed of erection. No scaffolding need be used as the windows are designed to be put in from the inside. Other ways in which the speed of erection could be increased should be discussed, e.g. simple methods for connecting components. There are several possible answers to *e*) (and students can describe the types of cladding used on local buildings). Usually a prefabricated building firm will offer a client several alternatives such as steel sheets or concrete panels.

As an extra exercise ask students to give the name of the person who:

a) supervises the labourers on site
b) excavates the foundations
c) erects the steel frame
d) builds the brick cladding
e) lays the roof covering
f) installs the finned heating element
g) installs the electrical services
h) draws up the preliminary plans of a building

Answers to exercises

Exercise 1

Possible answers:

Why is the steel frame erected before the precast concrete floor units have been fixed?
Because the precast concrete floor units are supported by the steel frame.

Why is the metal roof decking laid after the steel frame has been erected?
Because the metal roof decking is supported by the steel frame.

Why are the services passed through pre-cut slots in the stanchions before the inner lining panels have been fixed?

Because the workmen require access to the stanchions to pass the heating, electrical and telephone services through pre-cut slots.

Why is the steel frame erected before the suspended ceiling has been fixed?
Because the suspended ceiling is supported by the steel frame.

Why are the steel stanchion casings with fibreboard lining fixed before the wall planks have been fixed?
Because the wall planks are fixed to the steel stanchion casings.

Why is the gutter fixed before the three layers of felt have been laid?
Because the three layers of felt are laid over the edge of the gutter.

Why are the aluminium head flashings fixed after the aluminium framed windows have been fixed?
Because the head flashings are fixed to the window frames.
etc.

Exercise 2
The stanchions are spaced at 3 000 mm centres.
The span of the beams is 9 000 mm.
The height from ground level to the bottom of the parapet is 10 800 mm.
The parapet is 600 mm high.
The roof zone is 900 mm thick.
The floor zone has a thickness of 900 mm.

Exercise 3
a) aluminium head *b*) window frame *c*) window sill *d*) inner lining panel *e*) grill *f*) cavity for the heating and electrical services *g*) finned heating element *h*) wall plank *i*) brick cladding

Exercise 4
While the steel frame is being erected, the wall planks and floor units are fixed. At the same time the stanchions are enclosed in casings. Then the aluminium heads, sills and windows are fixed from inside the building. After this the 900 mm and 1 800 mm wide external doors are installed. Finally, the internal sills and lining panels are installed.

Exercise 5
Possible answers:

a) The external walls are made up of brick cladding, wall planks, windows and doors.

b) The wall planks and floor units are fixed while the steel frame is being erected.

c) The stanchion casings serve the function of resisting fire.

d) The precast concrete floor units are capable of carrying a load up to 5 kN/sq m.

e) The wall planks are designed to be weatherproof and to support the outer cladding.

f) The external doors are 900 mm and 1 800 mm wide.
g) The glazing of the hardwood framed doors is done on site.
h) The internal sills and lining panels form a cavity for the heating and electrical services.
i) The grill is located underneath the sill.
j) The grill and air intake enable air to circulate up past the finned heating element.
k) The lining panels are capable of being removed to give access to the services.

Exercise 6
a) To avoid erecting scaffolding.
b) To transfer heat from hot water to the air.
c) No, they aren't.
d) They are lighter and corrosion resistant.
e) Corrugated steel sheets.
f) Offices, schools, etc.

Extra exercise
a) Foreman *b*) Machine driver *c*) Steel erector *d*) Bricklayer *e*) Roofing contractor (or roofer) *f*) Heating contractor (or heating engineer) *g*) Electrician *h*) Architect

UNIT 7 Measurement 2 Quantity

Aims
To extend the notion of measurements to include expressions of quantity (including relative quantity), and ways of expressing sufficiency and insufficiency; the suitability of materials for different tasks; design faults and conflicting design requirements in buildings.

Main language items
Ways of expressing relative quantities: e.g. *1¼ times as big as*

Modification of comparative quantities: e.g. *slightly bigger, considerably bigger, much bigger*

Expressions of sufficiency and insufficiency: e.g. *too* + adjective; (*not*) adjective + *enough; sufficient* + noun; *insufficient* + noun; *excessively* + adjective; *adequate, inadequate.*

Notes

SECTION 1
The first part of Exercise 1 illustrates the difference between *slightly bigger, considerably bigger* and *much bigger*, as well as introducing the expression *X is approximately N times as big as Y*. The exercise should be extended to the relative sizes of rooms in a real building.

In Exercise 2, first read through the table and explain the idea of relative cost. Introduce the expressions: *Glass is twelve times more expensive than concrete; Concrete is twelve times cheaper than glass*; and practise comparing other materials. This could lead to a discussion of why some materials are more expensive than others. The cost of building materials depends on the scarcity of the raw material, the amount of processing it has to undergo and the distance it has to be transported. The actual cost of the materials in the local currency could be determined and the exercise made more realistic.

In Exercise 5, the students should work in pairs producing dialogues which they then act out in front of the class. With the more advanced students the dialogue could be extended into an argument, e.g. *Well, I don't think we should use mild steel. It needs painting too often. I don't want to pay excessive maintenance costs.*

In Exercise 6, the information collected should be presented in tabular form. Materials should be classified into local and imported.

All materials need a certain degree of strength to do their job so their relative strengths can be compared. To discuss the appearance of materials, you may have to introduce vocabulary items such as the colours, textures (*matt, rough, smooth, shiny, patterned*, etc.) and words such as *attractive, striking, good finish.*

Answers to exercises

Exercise 2

a) concrete *b*) mild steel *c*) hardwood *d*) mild steel *e*) glass *f*) aluminium *g*) glass *h*) aluminium *i*) pine *j*) oak and zinc

Exercise 3

a) Copper has a much higher density than aluminium.
b) Zinc has a slightly higher tensile strength than oak.
c) The tensile strength of mild steel is approximately four times that of aluminium.
d) Glass has a slightly higher density than concrete.
e) Mild steel has a considerably higher melting point than copper.

Exercise 4

a) Glass is slightly heavier than concrete, has a much higher tensile strength and is 12 times more expensive.
b) Aluminium is considerably lighter than mild steel, has a much lower tensile strength and is approximately 4 times more expensive.
c) Copper is slightly heavier than zinc, has a much higher tensile strength and is $\frac{1}{4}$ (25%) more expensive.
d) Pine is considerably lighter than mild steel, has a much lower tensile strength and is $\frac{1}{3}$ cheaper.

Exercise 5

CLIENT: What do you think is the best material to use for the beam?

ARCHITECT: Well, oak isn't really suitable. It's strong enough but it's too expensive. I think we should use pine. It's not only strong enough but it's also cheaper.

CLIENT: What do you think is the best material to use for the roof covering?
ARCHITECT: Well, copper isn't really suitable. It's too heavy. I think we should use zinc. It's not only light enough but it's also cheaper.
CLIENT: What do you think is the best material to use for the fire door?
ARCHITECT: Well, copper isn't really suitable. Its melting point is high enough but it's too expensive. I think we should use mild steel. Its melting point is not only high enough but it's also cheaper.

SECTION 2

In Exercise 7, a series of 'design faults' are shown diagrammatically. Go through each one with the students before attempting the exercise and discuss the situation. Introduce the expression *lack of* in *d*) and drill. Students should then work together in pairs to construct the question/answer exchanges using the example presented to help them. Note that one conversation consists of two questions with replies and they follow a logical sequence.

Exercise 8 is similar to Exercise 7. It examines the situation used in Unit 4, Exercise 4 where the architect has chosen the wrong dimensions. Most buildings contain design faults if examined carefully and these exercises should be extended by looking at a real building to see how successfully or not it works.

Exercise 9 illustrates the fact that an architect must often compromise between conflicting requirements. Other constraints not mentioned in the exercise include the requirements of keeping to a time schedule and a cost limit. A discussion could lead to the discovery of other constraints on an architect.

Answers

Exercise 7

a) Q1: Why is this person unable to hear the music?
A: Because the noise level is too high.
Q2: Why is the noise level too high?
A: Because the sound insulation is inadequate.

b) Q1: Why is this person unable to read the book?
A: Because the room is too dark.
Q2: Why is the room too dark?
A: Because the window area is not big enough.

c) Q1: Why is this person in danger?
A: Because the load on the roof is too heavy.
Q2: Why is the load too heavy?
A: Because the roof is not strong enough to support the load.

d) Q1: Why is this person unhappy?
A: Because he has a lack of privacy.
Q2: Why does he have a lack of privacy?
A: Because the window area is excessive.

e) Q1: Why is this person uncomfortable?
A: Because the humidity is too high.
Q2: Why is the humidity too high?
A: Because the ventilation is inadequate.

f) Q1: Why is this person wet?
A: Because the tiles are not weather resistant enough.
Q2: Why aren't the tiles weather resistant enough?
A: Because the roof pitch is too low.

Exercise 8

a) Q1: Why can't this man go through the door?
A: Because the doorway isn't wide enough.
Q2: Why isn't the doorway wide enough?
A: Because the architect didn't take into account the width of the widest person when he designed the doorway.

b) Q1: Why doesn't this man's feet touch the floor?
A: Because the seat is too high.
Q2: Why is the seat too high?
A: Because the architect didn't take into account the lower leg length of the smallest person when he designed the chair.

c) Q1: Why can't this man read the notices?
A: Because the notice board is too high.
Q2: Why is the notice board too high?
A: Because the architect didn't take into account the height of the shortest person when he located the notice board.

d) Q1: Why can't this man bend his legs?
A: Because the length of the seat is too long.
Q2: Why is the length of the seat too long?
A: Because the architect didn't take into account the upper leg length of the smallest person when he designed the chair.

e) Q1: Why can't this man reach the sink?
A: Because the sink unit is too wide.
Q2: Why is it too wide?
A: Because the architect didn't take into account the arm length of the smallest person when he designed the sink.

Exercise 9

a) When an architect designs the sizes of windows, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that there is an adequate window area and at the same time he needs to ensure that there is sufficient privacy.

b) When an architect designs the window area of a house, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that there is sufficient warmth and at the same time he needs to ensure that there is adequate light.

c) When an architect designs the thickness of sound insulation, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that the materials are cheap enough and at the same time he needs to ensure that there is adequate sound insulation.

d) When an architect designs the ventilation system, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that there is sufficient warmth and at the same time he needs to ensure that the humidity is not excessive.

e) When an architect designs a roof, he often has to strike a balance between two conflicting requirements. For example, he needs to ensure that the materials are cheap enough and at the same time he needs to ensure that the weather proofing is adequate.

SECTION 3

One of the main reasons why some buildings do not work very well is because the architect failed to pay sufficient attention to the local climate. It is climate which determines the shape and construction of most buildings. Climate also determines the life-style of people, e.g. the midday siesta in the hottest part of the day.

The reading passage is about the three major climatic zones in tropical regions and the effect of these climates on house design. The graphs present, for each climatic zone, the three main climatic variables of temperature, relative humidity and rainfall, and how these change over a twelve month period. The graphs look a little complicated as all three variables are presented on one graph for each climatic zone. The graphs should be discussed in detail before the passage is read and the different climatic zones matched with the graphs.

In Exercise 11, students will need to refer to a world map or an atlas. The location of the three towns should be established first and then the climate they experience should be identified. Latitude and longitude are often used in architecture and should be used here to give the precise location of the towns. Their climates should then be discussed with reference to the reading passage and graphs.

Exercise 12 requires a detailed reading of the graph. Exercise 13 shows the practical solutions of architects to modifying the effects of climates to produce more liveable conditions inside a house.

Exercise 15 requires some thought and should generate a lot of discussion. A project to build a model of a house suitable for a composite climate would be useful here. One solution is to place a house suitable for a warm-humid climate on top of a house suitable for a hot-dry climate. The occupants then move from one floor to the other depending on the season.

The drawings presented in Exercise 16 are intended to be the focal reference point of this book as the contents of most units can be extended by applying their concepts to the different types of buildings shown here. Initially, these drawings can be used to revise all the concepts presented in previous units such as properties of materials, location, structure, etc. Then the different forms of the buildings can be compared and the reasons for their shapes discussed, e.g. due to climatic influence, building function or for cultural reasons. Help the students in the discussion by giving prompts such as:

What about the roof pitch? Why is it so steep/gentle?
What about the wall thicknesses? Why are they so thick/thin?
What about the size of the windows? Why are they so big/small?

Answers

Exercise 10

Warm-humid climate – Climate B
Hot-dry climate – Climate C
Composite or monsoon climate – Climate A

Exercise 11

New Delhi – India – composite or monsoon climate
Phoenix – Arizona, U.S.A. – hot-dry climate
Mombasa – Kenya, Africa – warm-humid climate

Exercise 12

a) In Mombasa the humidity is excessively high for most of the time.
In New Delhi the humidity is excessively high during the summer and winter seasons.

b) In Phoenix the rainfall is insufficient for most of the time.
In New Delhi the rainfall is insufficient from October to July.

c) In Mombasa the rainfall is excessive in April and May.
In New Delhi the rainfall is excessive from June to September.

d) In Phoenix the heat is excessive from May to October.
In New Delhi the heat is excessive from April to September.

Exercise 13

Type A house is more suitable for a warm-humid climate. This is because it has an open layout and is orientated towards the prevailing wind. It has overhead sun protection and the building is raised to allow the wind to pass under for cooling. The walls have many openings and are able to be penetrated by the wind.

Type B house is more suitable for a hot-dry climate. It has a compact layout to reduce the surfaces exposed to the sun. It has a thick insulating roof and thick external walls with few openings. The building is made of heat storing materials so that it holds the heat of the day and gives it back to the interior at night.

Exercise 14

adequately; inadequately; excessively; warm enough; coolest; much lighter; cool enough; hottest

SECTION 4

The listening passage is in the form of a lecture and students have to listen intensively to be able to understand its contents. Diagrams 1 and 2 should be discussed before students listen to the passage. The terms *mathematical law, economical, girder* and *truss* should also be introduced and explained at this time.

Listening text

Today I'd like to talk about the effect of size in the design of structures. First of all, let us look at diagram 1 which shows two cubes. The large cube is twice as high as the smaller one, but it contains eight cubes the size of the smaller one. Can you see that? The smaller cube would fit into this corner here. The shaded part indicates

where the top of the small cube would go. So, from this we can see that if the spatial dimensions of an object are doubled, then its volume is increased eight times. O.K.? This is a very important mathematical law to consider when designing structural systems.

Right, now, let's see why. Look at diagram 2. It shows two beams and one of the beams is twice as big as the other. The large beam spans twice the distance of the small beam, however its volume is eight times greater and hence it weighs eight times as much. You can imagine that if the size of a beam made of stone was doubled then it probably would not be strong enough to support its own weight. You have to change the design of the beam or the material it is made from. Simple beams are suitable for supporting a surface over a small span. However, as soon as the spans extend much over six metres, simple beams become too large in cross-section and need to be too close together. You are then using far too much material and because of that the structure would cost a lot.

For spans over six metres you have to use a more economical structural system. Let me give you an example. In this structural system, girders are first placed across the major span, then beams are placed across the girders and finally the floor is put on top of the beams. This structural system now has three elements – the girders, the beams and the surface carried by the beams.

In spans of still greater size, the economical length of girders is exceeded. Then it becomes necessary to place trusses across the major span to carry the ends of the girders; the girders now support the smaller beams which in turn support the surface material. Of course, there are many other ways of spanning large distances using a number of different structural systems but I will talk about that another time.

Answers

Exercise 17

a) If the spatial dimensions of an object are doubled, then its volume is increased eight times. (or, If you square the area you cube the volume.)

b) Because they become too large in cross-section and need to be too close together.

c) Trusses are placed across the major span to carry the ends of the girders; the girders support smaller beams which support the surface material.

UNIT 8 Process 3 Cause and Effect

Aims

To extend the theme of process with ways of describing the results and explaining the causes of actions; causes of structural failure; processes in ventilation and heating systems.

Main language items

Clauses of result: e.g. *The column moved and as a result/with the result that the span increased.*

'Causative verbs' linking noun phrases of cause and result: e.g. *How did the subsid-*

ence of the foundation lead to/bring about cracks in the beam? The subsidence of the foundation resulted in/caused the movement of the column. Protecting the roof from the sun prevents it from expanding. Earthquakes lead to cracking in buildings.

Phrases of cause: e.g. *This is because of/due to inadequate thermal insulation. Houses in hot-dry climates have compact layouts owing to the high solar radiation.*

Participal phrases of result: e.g. *The air then leaves the basement through an outlet thereby helping to ventilate the courtyard. A failure in tensile strength may result in the collapse of the beam.*

Conditional clauses: e.g. *If moisture laden air is not allowed to escape from a building then condensation will occur.*

Sentence connectors expressing result: e.g. *Heating water causes the dissolved air contained in cold water to be released. Consequently, a vent pipe has to be taken from the top of the storage cylinder.*

Notes

SECTION 1

Exercises 1, 2 and 3 deal with the chain of cause and effect. First, introduce the idea of cause and effect with a few simple examples, e.g.

I open the window *with the result that/and as a result* fresh air comes in (the noise level increases/dust comes in).

I turn on/off the air conditioner/radiator *with the result that/and as a result* the room becomes cooler/warmer.

I close the curtains *with the result that/and as a result* the room becomes darker.

I switch on the light *with the result that/and as a result* the room becomes brighter.

Now check that the students understand the diagram in Exercise 1 and the words *deflected, cracks, subsided*. The exercise could be done orally or by having a student read out a cause/effect statement while another student draws a diagram of the effect on the board.

Exercise 2 should be done in pairs. Then point out the different sentence constructions in Exercise 3 and explain how a cause/effect table can be written out as in the model paragraph. Have students work in the same pairs to produce the written answers to the questions. Before doing Exercise 4 ask the students a few questions using *prevents*, e.g. *What prevents you from leaving the room? What prevents your body from getting cold? What prevents thieves from getting into your house?*

After the students have completed the sentences, discuss how architects design buildings to prevent certain things from happening, e.g. protecting materials to prevent deterioration of the building fabric, locating areas which require quiet away from noisy areas, making circulation spaces big enough so they do not get congested. Then practise using the opposite of prevent – *allow*, e.g. *a locked door prevents people from entering a building but an open door allows people to enter a building.*

In Exercise 5 the text should first be written on the board. Then check to see that the students understand the use of the words *because of, due to, depends on*. Con-

sequently is a sentence connector expressing result. Try and get the students to produce a few examples of its use, e.g. *I am hungry. Consequently, I should eat something*. Then relate the text to Unit 7, Exercise 7. Students then write three similar paragraphs working either individually or in pairs.

Answers to exercises

Exercise 1

The column moved with the result that the span increased.
The span increased and as a result the beam deflected excessively.
The beam deflected excessively with the result that cracks formed on the underside of the beam.

Exercise 2

a)

Cause	Effect
hardcore below the floor contained soluble salts	salts interacted with cement in concrete floor
salts interacted with cement in concrete floor	concrete floor expanded
concrete floor expanded	cracks formed in floor

b)

Cause	Effect
heavy rain washed away gravel on roof	roof inadequately protected from the sun
roof inadequately protected from the sun	roof heated up
roof heated up	roof expanded
roof expanded	wall/roof joint failed

c)

Cause	Effect
wood was painted with poor quality paint	moisture content of wood increased
moisture content of wood increased	woodwork expanded
woodwork expanded	later the wood dried and contracted
wood dried and contracted	gaps formed between window and frame

Exercise 3

a) The presence of soluble salts in the hardcore resulted in the interaction of the salts with cement in the concrete floor. This, in turn, caused the expansion of the concrete floor and the formation of cracks in the floor.

b) The washing away of the gravel by the rain caused inadequate protection of the roof from the sun. This, in turn, resulted in the roof heating up, the expansion

of the roof and the failure of the wall/roof joint.

c) The painting of the wood with poor quality paint resulted in an increase in the moisture content of the wood. This, in turn, caused the expansion of the wood, then later the drying and contraction of the wood and the formation of gaps between the window and the frame.

Exercise 4

a) . . . prevents them from interacting with the cement in the concrete floor.
b) . . . prevents it from expanding.
c) . . . prevents gaps forming between the window and the frame.

Exercise 5

a) We have a problem with the noise level in this room. It's too noisy. This is because of inadequate sound insulation. You see, to a certain extent, the noise level in the room depends on the thickness of the insulation. Consequently, we should increase the thickness of the insulation.

b) We have a problem with the amount of light in this room. It's too dark. This is because of inadequate window area. You see, to a certain extent, the amount of light in the room depends on the window area. Consequently, we should increase the window area.

c) We have a problem with the degree of humidity in this room. It's too high. This is because of inadequate ventilation. You see, to a certain extent, the degree of humidity in the room depends on the amount of ventilation. Consequently, we should increase the amount of ventilation.

SECTION 2

Before attempting Exercise 6 discuss the drawings of the courtyard house. Make sure the students understand that a party wall is one shared with another house. This exercise should generate a lot of discussion as students try to deduce the answers to the questions. The true/false statements in Exercise 8 should also involve a lot of discussion as the answers largely depend on the background and experience of the students. Each sentence presents a different way of expressing a causal statement. These language items can be practised by making further statements:

T: Earthquakes lead to cracking in buildings. True or false?
S: True.
T: Yes. What else leads to cracking in buildings?
S: Excessive loads.
etc.

Answers

Exercise 6

a) The wind tower faces the prevailing wind.
b) The wall is very thick and does not receive any direct solar radiation.
c) The incoming air comes into contact with the surfaces of the duct.
d) The air is passed over porous water jugs.
e) The air leaves the basement through an outlet.

Exercise 7

a) The walls should be made of a massive heat-storing material such as mud. This is because mud walls are not easily penetrated by the sun's rays so the inside of the house will remain cool for a long time.

b) To direct the wind through the duct into the basement of the house.

c) Because the party wall is very thick and does not receive any direct solar radiation.

d) So that water can pass through to the outside of the jugs and be picked up by the incoming air.

e) Because warm air rises, so the lower part of the courtyard would not be ventilated if the cooled air was let into the courtyard from the bedroom.

f) The courtyard and the surrounding buildings radiate to the cold night sky and, during the night, a pool of cool air is built up in the courtyard and in the ground floor rooms. During the day the sun shines but the reservoir of heavy cool air remains for a considerable time.

g) The entrance to the house is on the left-hand side of the wall facing the alley.

h) The bedroom next to the party wall would be the best to sleep in because it is the coolest bedroom.

Exercise 8

a) True.

b) True.

c) False. Frequent painting of steelwork prevents corrosion.

d) False. Insulating a house prevents the air inside from cooling to its dew point.

e) False. The expansion of a roof is caused by an increase in temperature.

f) False. In an arch the bricks are wedge-shaped thereby causing their weight to be distributed downwards along the curve of the arch.

g) True.

h) True.

i) False. The contraction of a column is due to compressive forces.

j) True.

k) True.

SECTION 3

In Exercise 9 the students should first look at the diagram of the domestic hot-water system. Make sure they understand that the diagram is a section through a house showing three levels and that the lines represent a pipe network. Discuss where hot water is needed in a house, how the water can be heated and what fuels could be used. Students should read the passage individually and complete both Exercises 9 and 10. Then students should describe orally how a circulation of water is set up in the hot-water system. They should use this description as a model for describing how air circulates in a heated room.

As a follow up to these exercises, students should say where the best place is to locate radiators in a room. They are usually located under windows so that the air does not cool on the window and cause condensation. They can also find out what types of heating and cooling systems are used in their country and their relative advantages and disadvantages.

Answers

Exercise 9
a) vent pipe *b*) cold-water cistern *c*) PF *d*) PR *e*) boiler *f*) draw-off point

Exercise 10
a) hot water *b*) safety valve *c*) bath *d*) water closet

Exercise 11
a) To replace water drawn-off from the system.
b) To the top of the cylinder. To effect circulation of water by convection.
c) It becomes less dense.
d) By not maintaining a temperature difference between the water in the primary flow and that in the primary return. In other words, by turning off the boiler.
e) The pressure due to the height of the water in the feed tank.
f) To prevent the formation of air locks.
g) The boiler could explode.

Exercise 12
a) . . . it becomes less dense than the cold water in the higher parts of the system.
b) The displacement of the heated water . . .
c) . . . the process of convection . . .
d) A temperature difference is maintained between the water in the primary flow and that in the primary return, . . .
e) . . . the height of the water in the feed tank.
f) . . . it collects at the top of the storage cylinder.
g) . . . a pipe which allows air to escape from the system.
h) . . . a reduction of pressure in the boiler.
i) If the draw-off point is opened . . .

SECTION 4

The listening passage is a long dialogue in the form of a radio interview. Students are required to listen and complete the notes using abbreviations. As the dialogue is so long, it should be dealt with in two parts with a rest between the two sections. In Exercise 13, first discuss the vocabulary items and then discuss how they can be abbreviated. Two methods of abbreviation are indicated in the example: the first method is to abbreviate by removing the vowels, e.g. *structural failure* can be shortened to *str. flr.* and the second method is to just use the first letter of each word, e.g. *reinforced concrete* can be shortened to *r.c.* After completing the exercises, students can go through the text underlining all the language items in it connected with cause and effect. As an extension exercise, students could be taken on a tour of some buildings looking for building defects and trying to identify their cause.

Listening text

(PART ONE)

INTERVIEWER: Professor, why do buildings sometimes fall down?

PROFESSOR: Basically, a building collapses because of some kind of structural failure.

INTERVIEWER: And what is the cause of such structural failure?

PROFESSOR: Well, there are many causes of structural failure, but they can all generally be divided into two categories. The first category can be defined as faults in design.

INTERVIEWER: You mean these faults are caused by architects?

PROFESSOR: I'm afraid so, yes. Architects who don't do their jobs carefully enough, or builders who don't carry out the architect's instructions properly. Whatever the cause, the effect is the same: a building or a bridge or some other such structure may collapse and cause death or injury.

INTERVIEWER: Can you give me an example of what you mean?

PROFESSOR: Yes, let's take reinforced concrete as an example. As you know, this is concrete strengthened by bars of steel. But if a reinforced concrete beam does not contain enough steel, its tensile strength may be affected.

INTERVIEWER: And what will happen then?

PROFESSOR: Well, if the beam is subjected to a heavy load, a failure in tensile strength may result in the collapse of the beam.

INTERVIEWER: I've been reading recently about the dangers of high alumina cement.

PROFESSOR: Ah yes, that's another good example – high alumina cement. This type of cement was originally used because it was much lighter but appeared to be very strong.

INTERVIEWER: And isn't it?

PROFESSOR: Usually, yes. But under certain conditions a weakness can develop. This weakness is caused by a chemical reaction in the cement itself.

INTERVIEWER: And that can be dangerous . . .

PROFESSOR: Well naturally, because any weakness in the cement directly affects the strength of the roof support or wall that is built from it.

(PART TWO)

INTERVIEWER: Professor, you mentioned two categories of structural failure.

PROFESSOR: Yes . . . the first category, as I said, comprises faults in design, in other words mistakes made by men. The second category comprises structural failures due to natural causes.

INTERVIEWER: What exactly do you mean by natural causes?

PROFESSOR: An obvious example is an earthquake, like the one in South America recently.

INTERVIEWER: And what is the effect of an earthquake?

PROFESSOR: An earthquake shakes the foundations of a building, causing enormous stress and strain on structures that simply cannot withstand them. The result is that the whole structure collapses under the strain.

INTERVIEWER: And then you have other causes like floods and hurricanes, I suppose?

PROFESSOR: Yes indeed, floods and hurricanes can have the same effects as earthquakes. Floodwater can cause damage to foundations, and hurricanes can blow down walls or send roofs flying into the air.

INTERVIEWER: Luckily we don't get too many things like that in this country.

PROFESSOR: Perhaps not. But even normal weather conditions can cause structural failures.

INTERVIEWER: Normal weather conditions? How can they affect buildings?

PROFESSOR: Well, take rot, for example. You can get dry rot or wet rot. Both are caused by dampness in the soil or in the atmosphere, and also simply by rain. Rot can have a very bad effect on the timber structures, that is the woodwork, of the older buildings.

INTERVIEWER: And finally I suppose, there is simply old age?

PROFESSOR: That's true. Buildings, like people, grow old, and age can affect the structural strength of a house or a bridge, even if it is made of the strongest materials.

Answers

Exercise 13

h.a.c.	cllps of bm
erthquks	fndtns
t.s.	c.r.
strn on str	r.s./w.
n.c.	

Exercise 14

Causes of structural failure

There are two types of cause:

1. Faults in design

These may be due to mistakes by architects or builders

e.g. a) reinforced concrete beams
cause: insufficient steel
result: tensile strength affected, leading to collapse of the beam

b) high alumina cement
cause: chemical reaction which affects strength of roof support or wall

2. Natural causes

e.g. a) earthquake
effect: (i) shake foundations
(ii) causing stress and strain on structure
leading to
(iii) collapse of structure

b) Other causes include floods and hurricanes

c) In normal conditions, failure caused by dry rot and wet rot

d) Old age

Exercise 15

Causes of structural failure

There are two types of cause. The first is faults in design. These may be due to mistakes by architects or builders. For example, if there is insufficient steel in a reinforced concrete beam its tensile strength will be affected and this could lead to the collapse of the beam. Another example is high alumina cement. A chemical reaction in the cement can affect the strength of a roof or wall made from the cement.

The second cause of structural failure is natural failure. For example, earthquakes can shake the foundations of a building causing stress and strain which could lead to the building collapsing. Other causes include floods and hurricanes. In normal weather conditions failure can be caused by dry rot and wet rot. Finally, old age can be a cause of structural failure.

UNIT 9 Measurement 3 Proportion

Aims
To describe the dimensions of one element of a building in relation to those of another; the effect of the perimeter/floor area ratio and surface area/volume ratio on the design of buildings; direct and inverse proportion in relation to heat loss.

Main language items
Expressions of ratio: e.g. *The ratio between the length and width of Room A is 5:3.*

Comparing one with another: e.g. *Compared with a water tower a micro-wave tower supports a relatively light load and has a proportionately thinner tower structure.*

Phrases used in presenting an argument: e.g. *We can see that . . .; We can conclude that . . .; We can predict that . . .; The explanation for this is that . . .*

Sentence connectors used in arguments: e.g. *consequently, conversely.*

Direct proportion: e.g. *Heat transfer is directly proportional to surface area. The higher the ratio between surface area and volume, the faster the rate of heat transfer.*

Inverse proportion: e.g. *Heat transfer is inversely proportional to volume. The smaller the size of the building, the more quickly it gains or loses heat.*

SECTION 1

Notes
Section 1 conveys the idea of relative size which is important in discussing the design of buildings. For example, heavy buildings have to have relatively thick supporting parts. Introduce the language items presented in the first part of Exercise 1 and practise them in relation to the rooms in an actual building. Then, with the students working in pairs, get them to ask and answer questions comparing the towers and the residential buildings. Exercise 2 should be written by the students individually. The phrases used in presenting an argument are introduced in Exercise 3. Observations are compared and a conclusion is drawn. This is followed by an explanatory theory and the resulting implications of the theory. Once the blanks have been filled in for paragraphs a) and b), they can be used as models to help students do Exercise 4.

Answers to exercises

Exercise 1
a) the water tower *b*) the tropical house *c*) its columns *d*) its structure

e) approximately one to four *f*) approximately two to three *g*) the tropical house *h*) approximately four to one *i*) approximately eight to one *j*) the block of flats

Exercise 2

In comparison with a water tower, a micro-wave tower supports a relatively light load and has a proportionately thinner tower structure.

Compared with a micro-wave tower, a water tower supports a relatively heavy load and has a proportionately thicker tower structure.

In comparison with a block of flats, a tropical house supports a relatively light load and has proportionately longer columns.

Compared with a tropical house, a block of flats supports a relatively heavy load and has proportionately shorter columns.

Exercise 3

a) are relatively long and thin; the lighter building needs proportionately longer and thinner columns.

b) thickness; length; thicker; shorter; the thinner and longer its columns.

Exercise 4

If we compare the structure supporting the two towers, we can see that the structure of the water tower is relatively short and thick in proportion to its size, while that of the micro-wave tower is relatively long and thin. We can conclude that the heavier tower needs a proportionately shorter and thicker structure, whereas the lighter tower needs a proportionately longer and thinner structure.

The explanation for this is that short thick structures are stronger than long thin ones since the strength of the structure depends on its thickness and length. Supporting strength is directly proportional to thickness and inversely proportional to length. Consequently, the heavier the tower, the thicker and shorter its structure and conversely, the lighter the tower, the thinner and longer its structure.

Exercise 5

a) True.

b) False. The structure of the water tower has to support more weight than that of the micro-wave tower.

c) True.

d) False. The strength of a column is directly proportional to its thickness and inversely proportional to its length.

e) False. Compared with a water tower, a micro-wave tower has a relatively tall structure.

f) False. The lighter the load on a tower, the thinner its structure.

g) False. Similarly, the lighter a building, the thinner its columns.

SECTION 2

A very important principle in architecture is introduced in this section. The perimeter/floor area ratio and the surface area/volume ratio have a very big effect in de-

termining the overall shape and cost of a building. In general, the larger the building, the cheaper the cost of materials per unit floor area and the cheaper it is to heat or cool the building. The most compact shape is a sphere but that is not a practical shape for most buildings. Buildings shaped like a cube are often impractical because of the difficulty in lighting and ventilating the innermost part. That is why buildings sometimes surround a courtyard. Exercises 6, 7 and 8 help students to an understanding of the importance of ratios in architecture by getting them to calculate the perimeters, areas and volumes of different shapes. The language of argument, introduced in Section 1, is extended in this section. In Exercise 8, follow the same process as presented in Exercise 7. Help the students do this exercise by giving them the following formuli:

The surface area of a sphere is $3{\cdot}14\ D^2$
The volume of a sphere is $0{\cdot}52\ D^3$ (where D is the diameter).

The surface area of a cube is $6\ L^2$
The volume of a cube is L^3 (where L is the length of one side).

The surface area of a rectangular prism, with two equal sides (W) and where the longest side is 2 metres long, is $2W^2 + 8W$.
The volume of this rectangular prism is $2W^2$.

Now if they all have the same volume, say, 1 cubic metre, then the following calculations can be done:

$0{\cdot}52\ D^3 = 1$ therefore $D = 1{\cdot}24$ m
so, the surface area of this sphere $= 3{\cdot}14\ (1{\cdot}24)^2 = 4{\cdot}83\ m^2$
$L^3 = 1$ therefore $L = 1$ m
so, the surface area of this cube $= 6 \times 1 = 6\ m^2$
$2W^2 = 1$ therefore $W = 0{\cdot}71$ m
so, the surface area of this rectangular prism $= 2(0{\cdot}71)^2 + (8 \times 0{\cdot}71) = 6{\cdot}68\ m^2$

Answers

Exercise 6
Building A
a) Floor area = 9 square metres
b) Perimeter = 12 metres
c) Perimeter/area ratio = 4 : 3
Building B
d) Floor area = 36 square metres
e) Perimeter = 24 metres
f) Perimeter/area ratio = 2 : 3
g) smaller *h)* longer

Exercise 7
a) 56 m; 70 m
b) rectangular building; compact shape; largest
c) compare; see; the smaller the perimeter
d) conclude; perimeter/area; shape; size

SECTION 3

The reading passage explains how the surface area/volume ratio affects the rate at which a building gains or loses heat. Before attempting Exercise 9, go through the vocabulary items presented in the diagrams. Discuss how buildings gain heat, e.g. from the sun, mechanical equipment such as a refrigerator and the heat from peoples' bodies, and how buildings lose heat, e.g. through openings such as a chimney, door or window and through uninsulated walls and roofs. Insulation prevents heat transfer so it is important to insulate buildings in very cold climates to prevent heat loss, and to also insulate them in very hot climates to prevent heat gain. In those countries there will be a high temperature gradient across the walls of a building, i.e. the difference in temperature between the inside and outside of the wall. The reading passage started in Exercise 9 is concluded in Exercise 10 with a generalisation about the behaviour of buildings. The questions in this exercise involve applying generalisations about buildings arrived at in the previous exercises to specific cases. Students should work in pairs and then each pair present their ideas to the whole class.

Answers

Exercise 9

Heat transfer is directly proportional to surface area.
Heat transfer is inversely proportional to volume.
Heat transfer is directly proportional to air temperature gradient.
Heat transfer is inversely proportional to thickness of insulation.

Heat loss is directly proportional to surface area.
Heat loss is inversely proportional to volume.

Heat gain is directly proportional to surface area.
Heat gain is inversely proportional to volume.

Heat retention is inversely proportional to surface area.
Heat retention is directly proportional to volume.

The higher the ratio between surface area and volume, the faster the rate of heat transfer.
The lower the ratio between surface area and volume, the slower the rate of heat transfer.
The smaller the size of the building, the more quickly it gains or loses heat.
The larger the size of the building, the more slowly it gains or loses heat.
The thicker the insulation of a building, the slower the rate of heat transfer.
The more compact the shape of a building, the more it retains heat.
The less compact the shape of a building, the less it retains heat.

Exercise 10

a) A hemisphere is an extremely compact shape. Therefore an igloo has a low surface area/volume ratio and consequently will lose heat less quickly than a building which has a greater surface area/volume ratio. It is particularly important to conserve as much heat as possible in the Arctic as the cold there can be very intense.

b) Mud is a dense material and it acts as a good thermal insulator. A thick mud wall

insulates the interior [illegible] transfer is inversely proportional to thickness of insulation, the thicker the walls, the lower the rate of heat transfer. Consequently, the interior of a house which has become cool during the night will be slow in heating up.

c) Heat transfer is directly proportional to surface area. Therefore the greater the surface area, the greater the heat transfer. In some tropical countries houses are built with a large surface area and the long side orientated towards the prevailing wind. The greater the surface area exposed then the greater the cooling effect of the wind.

d) Building B has a higher surface area/volume ratio than Building A. Now the higher the ratio between surface area and volume, the faster the rate of heat transfer. Therefore Building B loses the greater amount of heat. Building B is also higher than Building A and the higher the building, the greater the heat loss.

e) Heat transfer is directly proportional to surface area. The fins on a radiator increase its surface area. Consequently, the radiator is able to give off a greater amount of heat than if it did not have fins.

f) Both receive the same amount of radiation because both buildings are exposing the same area at the same angle to the sun. Solar radiation is greater in winter because the sun is lower in the sky and consequently, the walls are more directly at right angles to the sun's rays.

g) As both buildings have the same floor area and height, they both have the same volume. However, Building B has the greater perimeter/floor area ratio, and so has the greater surface area/volume ratio. Now, since heat transfer is directly proportional to surface area, Building B will be the more expensive to heat.

SECTION 4

The listening exercise follows up the idea presented in the reading passage by describing a mathematical method of calculating heat loss using the coefficient of thermal conductivity (k). Students should copy out the outline of notes and then complete them while listening to the passage. The text should preferably be delivered in the style of a lecture. Students should be encouraged to ask for clarification or repetition on any point of which they are not clear. Before doing the exercise revise the units of measurement noting that one watt equals one joule per second. As an extension exercise students can find out the k value of a wide range of materials. Discuss the relative advantages and disadvantages of using these materials in building from the point of view of heat loss and heat gain.

Listening text

Now today we are going to talk about measuring the heat lost from buildings by conduction. Some materials transmit heat more quickly than others. So, for example, if we compare brick and plaster, we find that brick transmits more than twice as much heat as plaster over the same period.

We use a number called the coefficient of thermal conductivity to help us calculate the rate at which a material conducts heat. Different materials have different coefficients and these are found by experiment. The bigger the coefficient the faster a material loses heat.

The coefficient of thermal conductivity is defined as follows – it's the number of

joules of heat flowing each second across the opposite faces of a material one metre long and with a cross-sectional area of one square metre where the faces of the material are kept at a temperature difference of one degree celsius. That's rather complicated isn't it? So let's look at the diagram of the rod. It shows the main points of the definition. I'll give you the definition again and you label the diagram. The coefficient of thermal conductivity is defined as the number of joules of heat flowing each second across the opposite faces of a material one metre long with a cross-sectional area of one square metre where the faces of the material are kept at a temperature difference of one degree celsius. Therefore k equals (note this equation down), k equals rate of flow of heat over cross-sectional area times the temperature gradient. The units of heat are (write this down, too) joules per second over metre times metre times degree celsius per metre. That is joules per second per metre per degree celsius or watts per metre degree celsius.

Now let's look at some typical values of k of materials used in building. I'll read them out with the material first followed by its k value and you complete the table: copper 380, iron 84, brick 1·15, plaster 0·50, timber 0·12, expanded polystyrene 0·03. If you look at these figures you will see that good conductors of heat such as copper have high k values, whereas poor conductors have low k values. For this reason, most of the materials used in house construction have low k values.

Answers

Exercise 11

a) temperature (T + 1)°C

b) (length = 1 m)

c) (area of cross-section = 1 m²)

d) $k = \dfrac{\text{rate of flow of heat}}{\text{cross-sectional area} \times \text{temperature gradient}}$

e) $\dfrac{\text{joules per second}}{\text{metre} \times \text{metre} \times \text{degree celsius per metre}}$

f) joules per second per metre per degree celsius or:

g) watts per metre degree celsius

h)

Material	k value
copper	380
iron	84
brick	1·15
plaster	0·50
timber	0·12
expanded polystyrene	0·03

Exercise 12

Brick wall

$$1{\cdot}15 = \dfrac{\text{joules per second}}{10 \times \dfrac{8}{0{\cdot}2}}$$

$$\text{joules per hour} = \frac{60 \times 60 \times 1{\cdot}15}{80 \times 5}$$

$$= 10{\cdot}35$$

Timber wall $$0{\cdot}12 = \frac{\text{joules per second}}{10 \times \frac{8}{0{\cdot}1}}$$

$$\text{joules per hour} = \frac{60 \times 60 \times 0{\cdot}12}{80 \times 10}$$

$$= 0{\cdot}54$$

a) 0·12 : 1·15, which is approximately 1 : 9·5
b) higher
c) directly
d) compare; brick; wood
e) see; higher; thicker

UNIT C Revision

Aims

To practise comprehension of the language of quantity, proportion and cause and effect in combination with other concepts from earlier units.

Notes

Students should work in pairs to discuss the answers to Exercise 1, and then their ideas presented to the group. Then discuss how bricks and concrete blocks are used in local buildings. Find a few bricks and blocks: measure them and discuss their relative ease of handling. Revise language from earlier units by having students describe their shape, their material properties and, e.g. the location of one defective block in a wall.

Stability is a very important consideration in mass construction buildings. The reading passage in Exercise 2 introduces three different design situations which are described in detail in Exercise 3. Note that *support* can be used as both a verb and a noun. Make sure that students realise that *support* is acting as a noun in the sentence *by connecting the edges of the panels to supports which are . . .* and in question *d*) point out that *panel supports* is a compound noun.

The reading passage continues in Exercise 3 with a typical extract from a design manual. This is an example of the code of practice style of English that architects have to master. Point out and discuss the structures: *may be, does not exceed, may not exceed* (in this context it means the same as *should not exceed*), *provided* (expresses a condition). Then practise them in different contexts, e.g. *Homework may be of any length provided that it is not less than 100 words*. To help the students match the design situations with the drawings, you could suggest they make brief notes about each design situation, e.g.

Dsgn Sttn 1 (i) any height $\rightarrow$ length $\ngtr 40 \times$ thickness
(ii) any length $\rightarrow$ height $\ngtr 15 \times$ thickness
(iii) length $(> 40 \times$ and $< 59 \times$ thickness)
$\rightarrow 133 \times$ thickness

Exercise 4 continues the theme of thermal resistance begun in Unit 9 and revises the language items introduced in that unit. When talking about the insulation properties of building elements which may be made up of several different materials, architects use U-values and not k (coefficient of thermal conductivity). Students should work in pairs to attempt Exercise 5, and afterwards the exercise worked through on the board for the whole class.

Introduce Exercise 6 by discussing the meaning of hard and soft water. Find out if the local water is hard or soft. The reading passage revises language items introduced in Unit 8 and discusses the main disadvantage of a direct hot-water system.

Answers to exercises

Exercise 1

a) 400 : 200 : 75 (16 : 8 : 3)
450 : 225 : 100 (18 : 9 : 4)
450 : 225 : 140 (90 : 45 : 28)

b) cellular tongued and grooved block

c) *Example answers*
The 140 mm cellular tongued and grooved block is the thickest.
The 75 mm solid tongued and grooved block is the thinnest.
The 140 mm cellular tongued and grooved block and the 100 mm cellular plain ends block have the same length and width.
The 75 mm solid tongued and grooved block is the lightest.
The 100 mm cellular plain end block has a higher thermal resistance than the 75 mm solid tongued and grooved block.

d) To make the joint between the two blocks more rigid.

e) Because it is lighter and uses less concrete. The air cavity also acts as an insulator.

f) For the same area of wall it is usually cheaper to use concrete blocks rather than bricks.
It is usually quicker to build a wall with concrete blocks rather than bricks, because there are fewer joints. This means that less mortar is used.

Exercise 2

a) Block walls can be divided into panels.
b) The height of the panel in relation to the thickness has to be limited.
c) The edges of the panels are connected to supports.
d) The panel supports are capable of transmitting the lateral forces to the structure.
e) If a wall is too thin, it will not have the stability to prevent overturning.

Exercise 3

Design situation 1	Wall B
Design situation 2	Wall C
Design situation 3	Wall A

The 75 mm solid block wall is unstable because its length exceeds 40 times its thickness.

The 100 mm cellular block wall is stable because its height does not exceed 30 times its thickness.

The 140 mm cellular block wall is stable because the length plus three times the height does not exceed 200 times the thickness.

Exercise 4

higher; lower; greater; high; low

Exercise 5

Example answers

r_1	3-layer bitumen felt
r_2	polyurethane foam felt
r_3	concrete slab
r_4	dense plaster ceiling

$$r_1 = \frac{0{\cdot}01}{0{\cdot}18} = 0{\cdot}056$$

$$r_2 = \frac{0{\cdot}025}{0{\cdot}023} = 1{\cdot}087$$

$$r_3 = \frac{0{\cdot}15}{1{\cdot}40} = 0{\cdot}107$$

$$r_4 = \frac{0{\cdot}016}{0{\cdot}50} = 0{\cdot}032$$

Therefore R $= 1{\cdot}282$

Total thickness $= 0{\cdot}201$m

U-value $= \frac{1}{R} = 0{\cdot}78$

Exercise 6

a) Soluble salts in the ground cause hard water.

b) Scaling is caused by deposits made by hard water when it is heated.

c) The temperature of the water.

d) Scale is a bad conductor of heat.

e) Heat is prevented from passing through the walls of the boiler.
The efficiency of the boiler is reduced.
The boiler walls may overheat.
The boiler plates may burn out causing leaks.

f) To be able to de-scale the inside of the boiler.

UNIT 10 Measurement 4 Frequency, Tendency, Probability

Aims

To present ways of expressing the frequency and tendency of the characteristics of buildings; the possibilities of natural disasters and their effects on buildings; risks and safety factors in building, including precautions against fire.

Main language items

Generalisations about how many members of a group possess certain properties: e.g. *All* buildings enclose space. *Some* buildings have air-conditioning.

Statements of frequency based on observations: e.g. Buildings *always* enclose space. Buildings *sometimes* have air-conditioning.

Statements of tendency: e.g. *People tend to come together in groups.*

Ways of predicting probability: e.g. *It is probable that an earthquake will cause serious damage in Japan. The chances that a major earthquake will occur in Peru in the next four years are high.*

Notes

SECTION 1

In Exercise 1, quantifiers are presented in descending order of size from *all* to *no*. They are shown corresponding to adverbs of frequency – from *always* to *never*. These statements are about the frequency of the characteristics of buildings and of the people who design buildings or live in them. Start by looking at the first diagram. Ask the students to give examples of buildings and discuss whether they enclose space. Try to think of any examples of buildings that do not enclose space. Bridges and micro-wave towers are structures and not buildings. After these initial questions, show on the board how *All buildings enclose space* can be transformed to *Buildings always enclose space*. Then continue this approach working through the remaining diagrams. Some items should generate a lot of discussion, for example, the statement *A few people build their own houses* may be true in industrialised societies but is probably not true in rural communities. Then have the students work in pairs to complete the statements. Their answers will depend largely on the local situation.

Begin Exercise 3 by explaining the idea of tendency. Tendency expresses something that is usually true but there are some exceptions. Ask the students to name all the different types of shelter people use, e.g. tents, boats, caravans. Then explain that one can say *People tend to live in houses*. The true/false statements should generate a lot of discussion. A well designed building allows for peoples' characteristics. Only badly designed buildings tend to be noticed as they are difficult to use, e.g. problems in finding the way around a building, or spaces that are too small for their function. As an extension exercise take the students to a building and get them to predict its layout before exploring it. Also, ask the students to produce sentences with *tend to* about the characteristics of their own people, e.g. *Egyptians tend to be very hospitable therefore their houses usually contain a room for entertaining guests.*

Answers to exercises

Exercise 1

Possible answers:

a) most *b*) nearly all *c*) many *d*) all *e*) some *f*) few *g*) a few *h*) very few *i*) many *j*) some *k*) very few *l*) most *m*) all *n*) very few *o*) no

Exercise 2

a) Architects generally study architecture at university.
b) Buildings nearly always have their entrances on the ground floor.
c) Bridges are often built of concrete.
d) Buildings invariably have doors.
e) People sometimes live in cities.
f) Blocks of flats are seldom over 50 metres high.
g) Architects are occasionally self-employed.
h) Houses are rarely prefabricated.
i) Shops are often accessible by car.
j) Buildings are sometimes built on rock foundations.
k) People are very seldom taller than 1·8 metres.
l) Factories usually have solid walls.
m) Buildings are always designed to keep out the weather.
n) Hotels are very rarely completely fireproof.
o) Buildings are never two dimensional.

Exercise 3

a) True.
b) True.
c) False. Climate tends to affect the design of buildings.
d) False. People tend not to sit in the sun when it is very hot.
e) False. People tend not to open the windows of their houses when it is cold.
f) True.
g) False. A tall building tends to be relatively more expensive than a low building.
h) False. In a house, the kitchen tends to be situated near the dining room.
i) False. A building with a simple plan tends to be less expensive to build than a building with a complex plan.

SECTION 2

Section 2 moves from observing how often things happen to predicting how likely they are to happen in the future. As an introduction to Exercise 4, revise Exercises 5, 6 and 7 from General Science Unit 10. Start the exercise by looking at the map of the world and identifying the location of seismic areas and cyclone zones. Then, using this information, go through the examples and work through the exercises deciding how big a danger exists in different countries. Exercise 6 deals with how architects learn from experience by making generalisations from observations. In areas where there is a strong likelihood of a natural catastrophe, architects must use their experience to minimise the risk to people and property. For example, in places where there is a high risk of earthquakes, architects can construct low buildings made of

light materials to minimise the danger should they collapse. Walls can be built sloping outwards so they fall away from the interior when they collapse. Check that students understand that the first two sentences of the passage are an *observation* and that the last sentence is a *generalisation*.

Exercise 7 widens the field from catastrophes which are usually limited to certain geographical areas to the more common hazards which can occur in any country. As an extension exercise, students should investigate nearby buildings to see if they have adequate protection against local hazards.

Answers

Exercise 4

a) improbable *b*) unlikely *c*) likely *d*) will *e*) might *f*) high *g*) a slight *h*) non-existent

Exercise 7

b) During a thunderstorm, structural damage was caused to a tall building, because a lightning conductor had not been fitted.
Structural damage is likely to be caused to a building during a thunderstorm if a lightning conductor is not fitted.

c) During a sandstorm, the exterior surfaces of a building were damaged because a barrier screen had not been erected.
The exterior surfaces of a building are likely to be damaged during a sandstorm if a barrier screen is not erected a few metres from the building.

d) During an attack by termites, the wooden components of a building were destroyed because the wood had not been treated with preservatives.
The wooden components of a building are likely to be destroyed during an attack by termites, if the wood is not treated with preservatives.

e) During a fire, structural damage was caused to a building because fireproof materials had not been used.
Structural damage is likely to be caused to a building during a fire if fireproof materials are not used.

SECTION 3

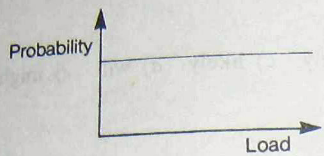
The reading text in Exercise 8 is about the different types of loads an architect must take into account when designing a structure and deciding how strong the structure should be. Note that in the text *load* means the same as *force*. Before starting the exercise ask students to try and list all the different types of forces that occur on a structure and to group them into two categories: highly unpredictable forces and highly predictable forces. Then introduce the idea of *factor of safety*: the idea of always having something in reserve in case something unlikely happens, e.g. taking more fuel than you need for a journey or having some savings in a bank. Students should then read the passage silently and then discuss the answers to the questions in groups.

Exercise 9 introduces a more mathematical way of measuring the chances of something happening. The statistics have to be converted into a diagram which represents frequency. From this graph we can deduce the likelihood of the weight of the next

vehicle on the bridge exceeding a certain value. This exercise will give students an idea of making observations to improve predictions.

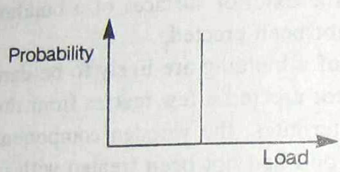
Exercise 10 is about collecting data to improve predictions about the strength of a structure. Students are required to draw a frequency diagram similar to the one they drew in Exercise 9. The data they use concerns the varying tensile strength of 74 identical components (there is an exercise in Nucleus: Engineering, Unit 11, which describes a method for testing tensile strength). The two graphs from Exercises 9 and 10 are compared in Exercise 11. To help students understand the concepts involved present the following two extreme cases:

Complete uncertainty:



In this situation there is an equal chance of a load of any magnitude occurring on the structure.

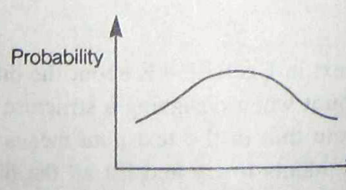
Complete certainty:



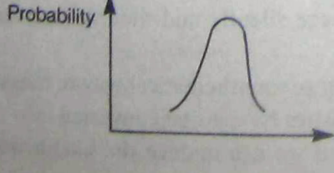
In this situation there is complete certainty about the exact magnitude of the load which will occur on the structure.

Both of the above cases are impossible in real life. Real-life situations tend to look like this:

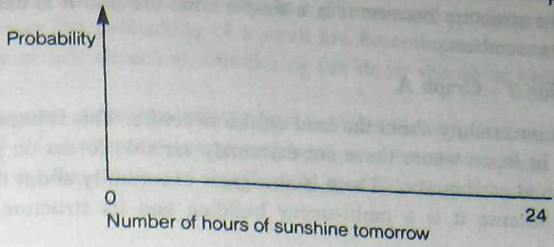
Where there is great uncertainty:



Where there is much more certainty about future behaviour:



Ask the students to try and draw similar graphs to represent local or personal situations, e.g.



Answers

Exercise 8

a) Yes. Because the loads from the internal partitions of a building rarely change with time and are usually fixed in one place.

b) No. Because the loads from storage in a building are always variable and movable.

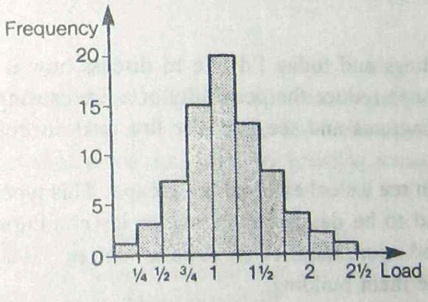
c) From past experience.

d) It is too dangerous because engineers never know the exact value of either the applied loads or the strength of the structure.

e) He chooses a high safety factor.

f) Failure occurs when the loads on a structure exceed its strength.

Exercise 9



a) impossible *b*) likelihood; low *c*) improbable *d*) $\frac{3}{4}$; $1\frac{1}{2}$

Exercise 10

a) False. Most of the components failed at a load between $1\frac{3}{4}$ and 2 tonnes.

b) True.

c) True.

d) False. No components failed over a load of $2\frac{1}{2}$ tonnes.

e) False. If these components are used in a bridge which is loaded to destruction, they will probably fail at a load between $1\frac{3}{4}$ and 2 tonnes.

Exercise 11

Design situation 1 – Graph B

There is great certainty about the load on the structure. This is because the weight

of water on the tower is easy to calculate. There is also great certainty about the strength of the structure because it is a simple structure and it is easy to calculate the sizes of its members.

Design situation 2 – Graph A

There is great uncertainty about the load on the structure. This is because the building is located in Japan where there are extremely variable forces on structures due to high winds and earthquakes. There is also great uncertainty about the strength of the structure because it is a multi-storey building and its structure is extremely complex.

Design situation 1 – Safety factor 2
Design situation 2 – Safety factor 6

SECTION 4

The theme of Section 4 is the danger of fire destroying a building. It is the architects' responsibility to reduce the risk of fire by careful design. Before listening to the passage, look at the pairs of diagrams. Each pair illustrates a design mistake and a way of reducing the danger. Students should work in pairs to discuss the drawings and then each pair should present their ideas to the whole group. Allow only a short discussion at this stage. The listening passage should be presented in the form of a lecture with students referring to the diagrams as they listen. Repeat the lecture this time with the students taking notes.

Listening text

Fire is a danger to all buildings and today I'd like to discuss how it is possible to design fire out of buildings or to reduce the possibility of a fire causing serious damage. So, let's look at the diagrams and see how the fire risks in buildings can be minimised.

In the first diagram, we can see a steel external fire escape. This type of fire escape is very popular but they tend to be dangerous in wet or icy conditions. People escaping from a fire may slip and injure themselves. A better solution is a fully enclosed fire escape set apart from the main building.

The next diagram shows that in this building the architect has forgotten about emergency vehicle access. In this case the fire brigade will have to fight the fire from the street. As it is a large building, there is a strong possibility that they will not be able to put it out.

Now look at the diagram of the stairs and the lift shaft. If there is a fire, people will probably need to use the stairs to escape. Consequently, these areas should always be clad with fire resisting materials.

Many buildings contain escalators. Fires tend to spread upwards through them and a small fire is far more likely to become a large one. To prevent this, fire resistant roller shutters should be used to cover the top of the escalator when a fire starts.

The next diagram shows a steel door holding back a fire. In this situation, the door can become an efficient heat radiator. The chances that the heat from the door will ignite combustible materials nearby are high. Therefore, all combustible materials should be kept at a safe distance from a steel fire door.

The cut-away drawing of a building illustrates the 'chimney effect' of a staircase in a building. The staircase tends to act as a chimney and produces a draught. This draught increases the probability of a small fire becoming a large one. To prevent the possibility of this occurring, self-closing fire doors should be installed on every floor.

The last diagram shows the effect of pressurising fire escape routes. Air is forced outwards and this keeps the smoke and heat away from the escape routes. It also tends to cool the fire doors and significantly increases their fire resistance.

Answers

Exercise 13

4, 7, 3, 5, 1, 6, 2

Exercise 14

Diagram 4

a) Fire escape not enclosed.

b) People may slip and injure themselves.

c) Fire escape should be fully enclosed and set apart from the main building.

Diagram 7

a) Fire brigade cannot gain access to the building.

b) May not be able to put out the fire.

c) Make sure that the vehicle access to the building is large enough to take a fire engine.

Diagram 3

a) Stairs and lift shaft not clad with fire resisting materials.

b) People might not be able to escape down the stairs during a fire.

c) These areas should be clad with fire resisting materials.

Diagram 5

a) The escalator does not have a roller shutter.

b) A small fire can become a large one.

c) A roller shutter should be installed.

Diagram 1

a) Combustible materials have not been located a safe distance from the fire door.

b) It is possible that heat from the door during a fire will ignite the combustible materials nearby.

c) All combustible materials should be kept a safe distance from a steel fire door.

Diagram 6

a) Doors have not been installed at each stair level.

b) The draught in the staircase tends to increase the probability of a small fire becoming a large one.

c) Self-closing fire doors should be installed on every floor.

Diagram 2

a) The corridor has not been pressurised.

b) The escape route may become blocked with fire and smoke.
c) Fire escape routes should be pressurised.

An architect may forget about emergency vehicle access. As a result, the fire brigade may have to fight the fire from the street. Therefore, if it is possible, vehicle access to a building should be large enough to take a fire engine.

The stairs and lift shaft can be set on fire. As a result, people may not be able to use the stairs to escape from a fire. Therefore, if it is possible, these areas should be clad with fire resisting materials.

Fire can spread upwards through an escalator. As a result, a small fire is more likely to become a large one. Therefore, if it is possible, a fire resistant roller shutter should be used to cover the top of the escalator when a fire starts.

A steel fire door can become an efficient heat radiator. As a result, combustible materials nearby could be ignited. Therefore, if it is possible, all combustible materials should be kept a safe distance from a steel fire door.

A staircase in a building can cause an upward draught. As a result, a small fire can become a large one. Therefore, if it is possible, self-closing fire doors should be installed on every floor.

The corridors of a building may not be pressurised to keep away smoke and heat. As a result, the escape route may become blocked. Therefore, if it is possible, fire escape routes should be pressurised.

UNIT 11 Process 4 Method

Aims

To present ways of describing methods and procedures such as the different kinds of work on a building site; the tools and instruments used; an experiment to investigate the effect of water content on the compressive strength of concrete; calculating the amount of daylight in a room.

Main language items

Specifying method or instrument with *by means of, by using, with*: e.g. *Holes may be drilled by means of a brace and bit.*

Specifying purpose with the infinitive of purpose and the phrases *in order to* and *so as to*: e.g. *A bricklayer uses a plumb-bob to check verticality. In order to check verticality a bricklayer uses a plumb-bob.*

Asking for and making recommendations using *should*: e.g. *If a bricklayer wants to check that the course of bricks he has laid is horizontal, which instrument should be use? He should use a spirit level.*

Key phrases in reporting experiments: e.g. *An experiment to investigate . . .; From these results we can calculate . . .; We can conclude that . . .*

Instructions with the imperative: e.g. *Place the concrete specimen on the lower compression plate.*

Passive verbs with *may* and *can*: e.g. *The indirect component can be obtained . . .*

Connectives introducing alternatives: e.g. *An alternative method . . .; Alternatively . . .; Another method . . .; One method . . .*

Notes

SECTION 1

This section is mainly concerned with how things are done on the building site: how the various jobs and measurements are carried out by tradesmen. The most common hand tools used are presented in Exercise 1. To complete the table with the correct tools revise *used* (+ infinitive) and *uses*, e.g.

T: What tool is used to drill holes in wood?

S1: A brace and bit.

T: Who uses a brace and bit?

S2: A carpenter.

Then complete the exercise by making sentences like the example: *A brace and bit is a tool for drilling holes in wood.*

Before starting Exercise 2, discuss the difference between *instrument* and *tool*. An instrument is a device for precise or delicate work – usually measuring, recording, detailing, making music, etc. A tool is usually designed for physical work – cutting, drilling, mixing, etc. *May* and *can* are less imperative than *should*, having more the force of suggestion than instruction. They also imply that there is more than one way of doing the action. *Can* and *may* are used interchangeably here. There is no difference in meaning, but *may* is slightly more formal.

As an extension exercise, visit a building site to make a list of all the tools and instruments used by the workmen. Look for alternative ways of doing the same job, e.g. a power drill can be used instead of a brace and bit for drilling holes in wood, and a theodolite can be used to check verticality instead of a plumb-bob. Also observe and describe the procedures used in doing jobs such as laying concrete foundations or building concrete block walls.

Answers to exercises

Exercise 1

a) brace and bit *b*) shovel *c*) float *d*) panel saw *e*) hacksaw *f*) cable shears *g*) mallet and chisel *h*) vice and file *i*) wire strippers *j*) screwdriver *k*) brush *l*) lump hammer and bolster *m*) spanner *n*) combination pliers *o*) plane *p*) trowel *q*) pincers

A shovel is a tool for mixing mortar.
A float is a tool for smoothing the plaster on a wall.
A panel saw is a tool for cutting wood.
etc.

Exercise 2

A lighting engineer uses a daylight factor meter to measure the illumination from the sky.
A structural engineer uses a strain gauge to measure the strain on a structure.
A bricklayer uses a plumb-bob to check verticality.
An acoustic engineer uses a sound pressure meter to measure the sound pressure.
A heating and ventilating engineer uses a hygrometer to measure the relative humidity.
A carpenter uses a spirit level to check vertical and horizontal work.
An electrician uses a voltmeter to measure the voltage of a circuit.
A bricklayer uses a steel tape to measure distances.
A carpenter uses a square to check squareness.
A heating and ventilating engineer uses a thermometer to measure the temperature.

Illumination may be measured by using a daylight factor meter.
Strain on a structure can be measured with a strain gauge.

Exercise 3

a) If a structural engineer wants to check that the strain in a beam is not excessive which instrument should he use?
He should use a strain gauge.

b) If an acoustic engineer wants to check the reduction in noise due to sound insulation which instrument should he use?
He should use a sound pressure meter.

c) If an electrician wants to check that a power circuit is working properly which instrument should he use?
He should use a voltmeter.

d) If a structural engineer wants to check that a column is vertical which instrument should he use?
He should use a plumb-bob (or a spirit level).

e) If a bricklayer wants to check that two walls are at right angles which instrument should he use?
He should use a square.

f) If a lighting engineer wants to check the daylight on a working surface which instrument should he use?
He should use a daylight factor meter.

g) If a bricklayer wants to check the length of a wall which instrument should he use?
He should use a steel tape.

h) If a heating and ventilating engineer wants to check the moisture content in the air which instrument should he use?
He should use a hygrometer.

i) If a heating and ventilating engineer wants to check the temperature difference between inside and outside which instrument should he use?
He should use a thermometer.

SECTION 2

This section uses an experiment to introduce a framework for reporting how experiments are carried out. The experiment is similar to one of a series of quality control checks that are usually carried out as concrete work is progressing in the construction of a building. The other main experiments that are done at this time are described in Nucleus: Engineering, Unit 11: methods of testing the workability and strength of concrete. These exercises are a useful extension after Section 2 has been completed. A report of an experiment will always start with an aim or purpose, which may be to show or investigate how or why something happens or to test a theory of hypothesis. The experiment presented here is to test the hypothesis that an excess of water weakens the strength of concrete. However, once data has been gathered about the strength of concrete for different mixes with different water-cement ratios, similar experiments can be done to check that the correct proportions of cement, sand, aggregate and water are being used to achieve the strength of concrete required by the specifications. In this case the purpose has changed but the procedure remains the same. Exercise 7 requires students to use the information presented to make a report of an experiment using Exercise 5 as a model. First, encourage them to discover the purpose of the experiment which is to investigate the effect of time on the compressive strength of concrete. Then have them transform the list of instructions into a paragraph describing the procedure. Finally, they should draw conclusions from the results.

Answers

Exercise 4

B 50; C 55 strength; reduced; water

Exercise 5

Results: Table; *Explanation*: Paragraph 2; *Apparatus*: Diagram; *Conclusion*: Paragraph 3; *Procedure*: Paragraph 1; *Purpose*: Heading

Exercise 6

Purpose:

An experiment to investigate the effect of time on the compressive strength of concrete

Description of apparatus:

(same diagram as in Students' Book, Exercise 4)

Procedure:

Three different mixes of concrete were separately prepared. The cement used in mix A was ordinary Portland, the cement used in mix B was rapid-hardening Portland

and the cement used in mix C was high alumina. Concrete cubes for each mix were cast in a steel mould with internal dimensions 150 mm by 150 mm by 150 mm and stored in a damp cabinet for 24 hours. The specimens were removed from the mould and immersed in water until the cubes were ready for testing. One concrete specimen was placed on the lower compression table. The upper compression plate was lowered on to the top of the specimen. The lever was raised and lowered to operate the hydraulic ram moving plate B upwards. The pumping action was continued until the specimen was crushed. The reading on the pressure scale was noted. The experiment was repeated for specimens from the three different mixes at different intervals of time.

Results:
(same results as table in Students' Book, Exercise 7)

Conclusion:
We can conclude that the strength of concrete is considerably increased as a result of the additional time. High alumina cement had reached its maximum compressive strength after 28 days, but the ordinary Portland and rapid-hardening Portland cement were still increasing in strength after one year.

SECTION 3
Both Sections 3 and 4 are concerned with methods for calculating the amount of daylight in a room. First discuss the diagram at the beginning of Exercise 8. The amount of daylight received from the sky will vary a great deal from the front to the back of the room. Architects choose important points in a room and measure the light received at these points. Usually the light is measured at a certain height above the ground called the working plane. Explain the following phrase taken from the reading passage: 'the projected solid angle subtended by the patch of visible sky at that point'. A solid angle is a three-dimensional angle and is formed, as shown in the diagram, by projecting lines from the point being considered to the four corners of the window. Students should read the passage silently then work in small groups to work out the answers to the questions.

Exercise 9 deals with connectives introducing alternatives and requires the student to extract the information required from the paragraph on indirect light in Exercise 8.

Answers

Exercise 8

a) To help calculate the amount of daylight in a room.
b) Light reflected from exterior buildings and from the ground, and light inter-reflected from the surfaces of the room.
c) How big a patch of sky can be seen from that point in the room, and the brightness of the patch of sky.
d) The sky component.
e) By using sky component protractors.
f) It can be laid directly on the working drawings.
g) No. It is inversely proportional to the area of the room.
h) It is decreased.

Exercise 9

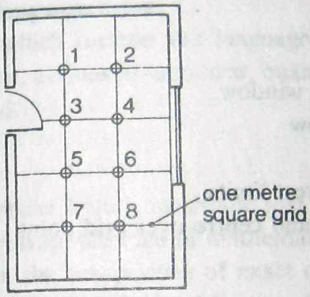
One method of calculating the indirect component of the daylight factor is by using nonograms. Alternatively, a simpler method may be used whereby the ratio is calculated by means of published tables. Another method of calculating the indirect component is by using a formula.

SECTION 4

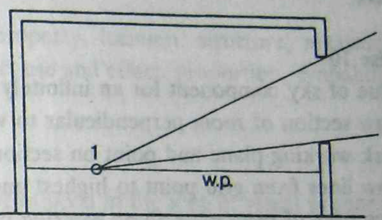
The listening passage gives instructions on how to use the sky component protractor. Students are required only to take notes on the procedure so they should be told to be selective in their listening. Some of the vocabulary used in the passage could be presented before the students listen to it and it could be abbreviated as was done in the listening exercise in Unit 8, e.g.

section – sctn; perpendicular – $\perp$; working plane – w.p.

In Exercise 12 students are required to use most of the information contained in Sections 3 and 4 to calculate the daylight factor at chosen points in an actual room, e.g.



Room plan



Section through room

Draw a plan of the room and then superimpose a one metre square grid on top of the plan. Number points on the grid as shown above and allocate a number to a pair of students. Then ask each pair to calculate the daylight factor at that point in the room at the height of a desk top above the floor. Each pair of students will need to make a sky component protractor. This can be done by tracing the illustrations of the protractor in Exercise 8 and sticking the tracings on card. After the students have done that they can follow the instructions given in the listening passage.

Listening text

Right. I'm going to give you some instructions on how to use the protractors to determine the sky component, so I'd like you to take notes.

The sky component consists of two values: the value of the sky component for an infinitely long window and this is multiplied by a value which is a correction factor, because windows are not infinitely long.

First, draw a section of the room perpendicular to the window. Then, mark the

working plane and the point under consideration on the section. After this, draw lines from the grid point to the highest and lowest limits at which the sky can be seen from the grid point. Then, place the base of the protractor along the working plane and the centre over the grid point, and read off the values. Finally, note the average altitude of the visible sky.

The resulting value is the sky component which would be received at the point from an infinitely long window. A correction must now be made for the limited length on the plan of the window.

To find the correction factor, first draw a plan of the room and then construct on the plan lines from the grid point to the edges of the visible sky. Next, place the correction factor side of the protractor on the plan with its base parallel to the window and its centre over the grid point. Now, using the value of the average altitude, choose the appropriate concentric scale and read off the correction factors for each side of the window. Add these factors to obtain a final correction factor where readings are on opposite sides of the centre zero. Where both readings are on the same side, subtract the smaller from the larger.

The sky component is calculated by multiplying the value for long windows found on the section by the plan correction factor.

Answers

Exercise 10

A Value of sky component for an infinitely long window

1. Draw section of room perpendicular to window
2. Mark working plane and point on section
3. Draw lines from grid point to highest and lowest limits
4. Place base of protractor along working plane and centre over grid point
5. Read off values
6. Note average altitude of visible sky

B Value of correction factor

1. Draw plan of room
2. Construct lines from grid point to edges of visible sky
3. Place base parallel to window and centre over grid point
4. Choose the appropriate concentric scale
5. Read correction factors for each side of window
6. Add where readings are on opposite sides of the centre zero. Otherwise subtract the smaller from the larger

Calculation of sky component

Multiply value for long windows by plan correction factor.

Exercise 11

First of all, a section of the room perpendicular to the window should be drawn. Then, the working plane and the point under consideration should be marked on the section. After this, lines from the grid point to the highest and lowest limits should be drawn. Next, the base of the protractor should be placed along the working plane and the centre over the grid point. Then, the values should be read off. Finally, the

average altitude of the visible sky should be noted.

First of all, a plan of the room should be drawn. Then lines should be constructed from the grid point to the edges of the visible sky. After this, the base of the protractor should be placed parallel to the window and its centre over the grid point. Next, the appropriate concentric scale should be chosen and the correction factor should be read off. Finally, where these readings are on opposite sides of the centre zero, they should be added. Otherwise, the smaller should be subtracted from the larger.

To calculate the sky component, the value for long windows should be multiplied by the plan correction factor.

UNIT 12 Consolidation

Aims

To revise language from all the previous units and to give practice in continuous reading in passages which show the various concepts and expressions in combination.

Main language items

Texts which include the language of property, location, structure, measurement, function, actions in sequence, quantity, cause and effect, proportion, probability and method.

Notes

In Exercise 1 students should first be introduced to the idea of visual proportions as distinct from the idea of mathematical proportion presented in Unit 9. In visual proportion the comparison of exact equality may be replaced by one which obeys the less strict rules of visual harmony. Proportion can be a matter of three dimensions or two. If possible, bring some works of art into the classroom which demonstrate what is meant by both good and bad proportion. Elicit the opinions of the students by asking questions, e.g. *Is this a beautiful object? Does it have good proportions? Is this object more pleasing to look at than that object? Why is this object ugly? (It has bad proportions.) etc.*

Now have the students look at the elevations in the first part of the exercise and point out that the windows in each elevation have different proportions. Ask the students to apply the same standards of judgement they used with the works of art to decide which elevation is the most pleasing to look at. Repeat the exercise with the rectangles doing a survey of all the class members. The data can then be presented on a graph. Students can be asked to canvass the opinions of their friends and these results compared with the results of the class survey.

Historically, architects have searched for a magic ratio which represents the ideal of perfect proportion. This they thought they had found in the Golden Section. Today, architects feel that the Golden Section is too deterministic and that beautiful buildings can be designed using a wide range of ratios. The reading passage in Exercise 2 introduces the idea of the Golden Section and you can see whether a majority

of the people canvassed in Exercise 1 agree with this. The two elevations show how strongly a change in the ratios used to design a building affect its visual appearance. Students should work in small groups to discuss the answers to the questions. At this point the concept of 'scale' can be introduced. A doorway in a house is 2 100 mm by 900 mm a size which is reasonably adequate for everyday use and which can be described as 'normal scale'. But if the doorway is only 1 400 mm by 600 mm, although the proportions remain the same, it is too small for its purpose and is therefore 'small in scale', or if it is 2 800 mm by 1 200 mm it is too big and is 'large in scale'. A design can be described as 'in scale' if it conforms to human norms or 'out of scale' if it is too big or too small in their context.

Exercises 4 and 5 describe the famous system of proportions and measurements invented by Le Corbusier. However, the whole system is based on the assumption that the average man has a height of 1 830 mm and there cannot be many cultures where this is true particularly if women are taken into consideration. These two exercises are a chance for students to explore their own feelings about proportions and systems of measurement and their importance in designing buildings and furniture.

Le Corbusier developed the modulor because the metric system is based on a rather abstract unit of measurement – the metre. The feet and inches system has much older roots and is a system which is related to the human body: a finger joint is an inch, the span of a hand is 4 inches, a foot is one foot long, a stride is one yard, etc. Because of this, it is sometimes easier for an architect to design a space using feet and inches rather than millimetres. However, the metric system is a more rational and complete system of measurement, so as architects have to design heating systems and analyse structures as well as spaces it is possibly the easier system to learn and use. Most of the European countries use the metric system but the USA still use the feet and inches system. The Japanese have been using a very strict system of ratios for many centuries and as a project students could investigate and report on this system.

Exercise 6 is an exercise in speed reading. It should be strictly timed and then the relevant sections of the reading passage identified.

In Exercise 7 students should work in pairs to choose a title for the paragraph and the reasons for their choice.

Exercise 8 requires detailed reading of the passage in order to extract the required information. First, ask the students to draw examples of the types of buildings found in hot-dry and warm-humid regions. Pick one example of a house from each type of region and draw them on the board. Then on each drawing show one method of overcoming glare. The students then copy the drawings and complete them by showing other methods of overcoming glare.

Exercises 9 to 12 revise a variety of language items around the theme of solar energy. If possible, arrange a visit to an installation which uses solar energy in some form.

Exercise 13 is an extended reading passage which examines the properties of locally available building materials in hot climate zones. As an extension exercise ask the students to find out what types of building materials used in their country are imported and whether they could be replaced by local materials.

Exercise 4

a) True.

b) False. The dimensions of column B are based on the height of the average man with his arm stretched up.

c) True.

d) False. The dimensions can be combined or divided to produce very large or very small dimensions.

e) True.

Exercise 6

a) sunlight being reflected from the surface of the ground and the light coloured walls of other buildings

b) the sky

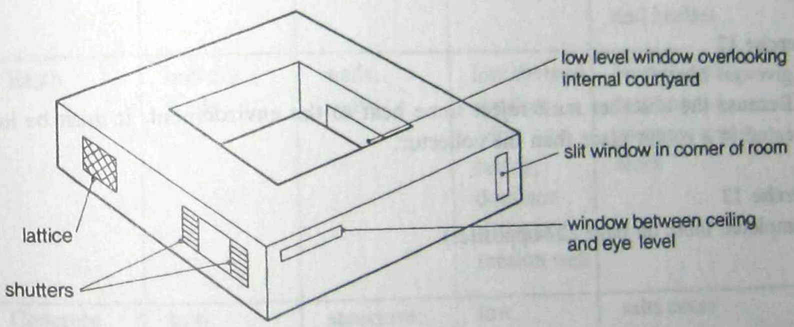
Exercise 7

Best title is: Methods of overcoming glare from the sky

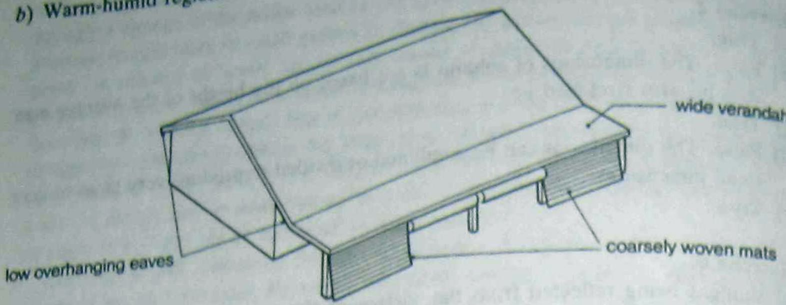
The difference between arid and humid regions – too general
Problem of admitting sufficient daylight – not sufficiently accurate
Glare and daylight – too specific

Exercise 8

a) Hot-dry regions



b) Warm-humid regions



Exercise 9

a) insulation *b*) absorber box *c*) cover *d*) absorber or heat exchanger
e) absorber box *f*) absorber *g*) insulation *h*) cover

Exercise 10

a) collector *b*) hot-water storage cylinder *c*) vent pipe *d*) insulation *e*) cover
f) absorber *g*) absorber box

Exercise 11

Correct order of sentences: *c*), *f*), *a*), *h*), *d*), *b*), *g*), *e*)
A – throttle valve; B – pump

Exercise 12

a) give out heat
b) Because the absorber must reject some heat to the environment, it must be located in a cooler place than the collector.

Exercise 13

(Completed table on page 227 opposite.)

Material	Availability	Use	Properties	Problems/ Durability
Cane, leaves vine, bamboo, palm-fronds	warm-humid zones	roofs	light; does not store heat; allows free passage of air	relatively short life span; deteriorates rapidly due to termite attack; highly combustible
Grass	intermediate and subtropical zones	roofs	light; does not store heat; allows free passage of air	relatively short life span; deteriorates rapidly due to termite attack; highly combustible
Hard-woods and soft-woods	tropical and sub-tropical zones (not hot-dry zones)	external wood-work		extremes of climatic conditions cause dimensional changes, producing cracks, splits and warping; wind-blown sand and grit gradually erode timber; liable to wet and dry rot; attacked by termites and beetles
Earth	hot-dry lands	walls; roofs	low thermal conduct-ivity; brittle; does not withstand tension well	termite damage may require frequent repair work
Concrete	hot-temperate zones	structure; found-ations; floor slabs	low resistance to passage of heat	salts cause corrosion of reinforcement and spalling of cover; rapid evaporation and shortage of water can result in low strength cracking and high permeability

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АНГЛО-РУССКИЙ СЛОВАРЬ

АНГЛО-РУССКИЙ СЛОВАРЬ

Список сокращений

A = Раздел A
a. = adjective прилагательное
adv. = adverb наречие
B = Раздел B
C = Раздел C
n. = noun существительное
pl. = plural множественное число
p.p. = past participle причастие прошедшего времени
pr. = preposition предлог
sing. = singular единственное число
v. = verb глагол

A

ability *n. 5* способность; умение
able *a. 5* способный
above *pr. 10* выше
absorb *v. 12* поглощать; впитывать
absorber *n. 12* 1) абсорбер; абсорбционный аппарат 2) поглотитель
absorption *n. 12* абсорбция; поглощение; лучепоглощение
absorption refrigerator *12* абсорбционный холодильник
abstract *a. 12* абстрактный
access *n. 2* доступ
accessible *a. 10* доступный; достижимый
accommodate *v. 5* предоставлять жилье
according to *pr. 12* согласно; в соответствии с
accurate *a. 12* точный, правильный
accurately *adv. 10* точно
achieve *v. 12* достигать
acoustic engineer *11* инженер-акустик
act *v. 1* 1) действовать 2) выполнять роль
action *n. 6* действие
act on *v. 3* воздействовать на что-л.
activity *n. 5* деятельность
actual *a. 4* действительный; подлинный
actual cost *6* реальная стоимость
add *v. C* 1) прибавлять; добавить 2) складывать
additional *a. 11* дополнительный
adequate *a. 7* достаточный
adhere *v. 3* прилипать; сцепляться
adhesive *n. 1* клей; клейкое вещество
adjacent *a. 2* примыкающий; смежный; прилегающий; соседний
adjustable louvre *5* регулируемые жалюзи
adjustable speed fan *5* регулируемый скоростной вентилятор
administration *n. 5* администрация
administration building *5* административное здание
admit *v. 12* 1) допускать; принимать 2) впускать
advantage *n. 3* преимущество
affect *v. 6* влиять; сказываться

age *n. 8* возраст; срок службы
aggregate *n. 4* 1) агрегат 2) заполнитель *(бетона)*
aim *n. 6* цель
air *n. 5* воздух
air cavity *C* воздушная полость
air cleaning *5* очистка воздуха
air conditioner *5* кондиционер воздуха
air conditioning *10* кондиционирование воздуха
air filter *5* воздушный фильтр; воздухоочиститель
air intake *B* воздухозаборник; входное отверстие воздухопровода
air lock *8* воздушная пробка; воздушный запор
air motion *5* движение воздуха
air opening *5* вентиляционное отверстие
air supported structure *7* пневматическое сооружение; пневмооболочка
airy *a. 7* воздушный; легкий
alley *n. 8* аллея; узкая улица; проход; проезд
allow *v. 4* позволять; допускать
almost *adv. 10* почти
alternative *a. 11* 1) альтернативный 2) переменный
alternatively *adv. 11* альтернативно
altitude *n. 11* высота
aluminium *n. 1* алюминий
always *adv. 10* всегда
ammonia *n. 12* аммиак
amount *n. 7* количество
ampere *n. 4* ампер
analyse *v. 12* анализировать
angle *n. 3* 1) угол 2) уголок 3) угольник
animal material *1* материал животного происхождения
anthropometric data *4* антропометрические данные
apartment *n. 5* квартира (из нескольких комнат)
apparatus *n. 11* прибор; устройство; аппарат
appear *v. 6* 1) появляться 2) оказаться
appearance *n. 5* внешний вид
application *n. 6* применение
apply *v. 10* 1) прилагать 2) применять
appoint *v. 6* назначать
appreciable *a. 11* заметный; ощутимый
appropriate *a. 11* 1) соответствующий 2) свойственный; присущий
approval *n. 6* одобрение
approve *v. 6* одобрять
approximately *adv. 2* приблизительно
aquastat *n. 5* аквастат
arc *n. 12* дуга; арка; изгиб
arch *n. 1* арка, аркада; свод
architect *n. 6* архитектор
architecture *n. 9* архитектура
arcuated *a. 3* дугообразный; аркообразный
area *n. 2* 1) площадь 2) район
arid *a. 12* сухой; засушливый
arm *n. 12* рука
artificial light *5* искусственное освещение
asbestos *n. 1* асбест
asbestos fibre *1* асбестовое волокно
asbestos wool *1* асбестовая вата
asphalt *n. 3* асфальт
assemble *v. 3* монтировать; собирать
assembly sequence *6* последовательность сборки
assist *v. 6* помогать
assume *v. 11* принимать *(характер, форму)*
assumption *n. 12* предположение; допущение
atmosphere *n. 8* атмосфера
attach *v. 3* прикреплять; присоединять
attack *n. 10* нападение
attractive *a. 5* привлекательный
auditorium *n.* (*pl.* **auditoria**) *5* зрительный зал
availability *n. 12* пригодность; доступность
available *a. 12* доступный; имеющийся в распоряжении
average *a. 4* средний
axis *n.* (*pl.* **axes**) *2* ось

B

back *n. 2* задняя, тыльная сторона
backrest *n. 4* спинка *(сиденья)*
balance *n. 7* равновесие
balcony *n. 4* балкон
balsa wood *6* древесина бальзы *(дерева)*
balustrade *n. 6* балюстрада; парапет; перила
bamboo *n. 12* бамбук
band *n. A* 1) связь; пояс 2) слой; прослоек
bank *n. 5* банк
bar *n. 8* пруток; арматурное железо
bar chart *6* гистограмма: столбцовая диаграмма
bark *n. 1* кора
barrel vault *1* 1) цилиндрический свод 2) бочарный свод
barrier screen *10* заградительный барьер
base *v. 4* базировать(ся); основывать(ся)
basement *n. A* 1) подвал 2) фундамент
basement storey *2* подвальный этаж
base plate *3* опорная плита; плита основания; фундаментная плита
batch *n. 11* порция; партия; пакет; серия
bathroom *n. 2* ванная комната
bay *n. 11* пролет; отсек; панель; ниша; секция
beam *n. 1* балка; брус; прогон
bear *v.* **(bore, born)** *1* выдерживать; нести нагрузку; подпирать; поддерживать
bearing strength *1* несущая способность; прочность на смятие
bear on *v. 3* давить; опираться на *что-л.*
because of *pr. 8* из-за; вследствие
become *v.* **(became, become)** *7* становиться
bedouin tent *7* бедуинский шатер
bedroom *n. 2* спальня
beetle *n. 12* древесный жучок
behaviour *n. 10* поведение
behind *pr. 2* сзади, позади, после
below *pr. 10* ниже
belt *n. 7* пояс
bench *n. 2* скамья
bend *v.* **(bent, bent)** *1* изгибать; гнуть
bending strength *1* прочность на изгиб; сопротивление изгибу
benefit *n. 7* выгода; польза
bent *a. 1* кривой; изогнутый; гнутый
between *pr. 2* между
beyond *pr. 2* 1) за 2) вне; сверх
bicycle factory *5* велосипедный завод
bid *v.* **(bid, bidden)** *6 зд.* участвовать в тендере
bill *n. 6* счет
bind *v.* **(bound, bound)** *3* связывать; скреплять
binder *n. 1* вяжущее вещество; вязочный материал; строительный раствор; цементирующая добавка
bit *n. 11* сверло
bitumen *n. 1* битум
bitumen felt *C* толь, рубероид
bituminous *a. 1* битумный
blind *n. 1* штора; экран
block *n. 1* корпус, блок, объем
block *v. 10* блокировать; загораживать
block of flats *5* многоквартирный дом
blow *v.* **(blew, blown)** *5* 1) дуть; развевать 2) взрывать
boat *n. 10* лодка; корабль; судно
body *n. 4* тело
boiler *n. 5* котел, бойлер
bolster *n. 11* долото каменщика
bolt *n. 3* болт
bolt *v. 3* свинчивать; скреплять болтами
bottom *n. 2* низ; нижняя часть
bound *v. 2* граничить; ограничивать
boundary *n. 2* граница; предел
box *n. 12* коробка; короб; кожух; ящик; бокс; блок
brace *v. 10* 1) скреплять 2) придавать жесткость
brace *n. 11* дрель
bracing *n. 6* 1) крепление; расшивка 2) связь-затяжка; связь жесткости

break *v.* **(broke, broken)** *6* ломать(ся)

breakdown *n. 10* 1) поломка; авария 2) срыв

breaking *n. 5* поломка

breeze *n. 2* бриз; легкий ветер

brick *n. 1* кирпич

bricklayer *n. 6* каменщик

brickwork *n. 6* кирпичная кладка

bridge *n. C* мост

brightness *n. 11* яркость

bring about *v.* **(brought, brought)** *8* вызывать

brittle *a. 12* хрупкий; ломкий

broad *a. A* широкий

brush *n. 11* кисть

build *v.* **(built, built)** *4* строить; сооружать

building *n. 1* здание

building materials *1* строительные материалы

building site *2* строительная площадка

build into *v. 3* вмонтировать; встраивать; замоноличивать

build *n. 4* лампочка

bungalow *n. 5* бунгало; одноэтажная дача с верандой; летний дом

burn *v.* **(burnt, burnt)** *5* гореть

burner *n. 5* топка, камера сгорания

bus station *5* автобусная станция

buttock *n. 4* ягодица

C

cabinet *n. 11* шкаф; ящик

cable *n. 11* кабель; многожильный провод

cable shears *11* ножницы для резания многожильного кабеля

calculate *v. 9* вычислять; подсчитывать; рассчитывать

calculation *n. 4* расчет

calf *n. 4* икра *(ноги)*

call *v. 10* звать; называть

cane *n. 12* тростник, камыш

canopy *n. 2* навес, козырек

cantilever *n. 3* консоль; кронштейн; укосина

cantilever *v. 3* выступать в виде консоли

cap *n. 3* головка; колпак; наголовник сваи

capable *a. 5* способный

capacity *n. 5* 1) способность 2) возможность

cap plate *3* шапочный брус

caravan *n. 10* 1) караван 2) дом-фургон

carbon fibre *1* углеродное волокно

card *n. 11* 1) карточка 2) картон

care *n. 12* 1) забота 2) внимание; осторожность

carpenter *n. 6* плотник

carrier fluid *12* жидкостный носитель

carry *v. 3* нести; поддерживать; проводить

carry out *v. 11* выполнять; осуществлять

case *n. 11* случай

casing *n. B* 1) оболочка; кожух 2) корпус 3) опалубка

cast *v.* **(cast, cast)** *11* отливать; лить

casting *n. 5* 1) литье; разливка; формование 2) отливка

cast iron *1* чугун

catastrophe *n. 10* катастрофа; гибель; несчастье

category *n. 8* категория; разряд; класс

cathedral *n. 7* кафедральный собор

cause *n. 8* причина

cause *v. 8* быть причиной; вызывать

cavity *n. B* полость; пустота

ceiling *n. 3* потолок

ceiling void *6* запотолочное пространство

cellar *n. 2* погреб; подвал

cellular *a. C* ячеистый, сотовый

cellular glass *C* пеностекло

Celsius *n. 4 (шкала)* Цельсия

cement *n. 1* цемент

cement binder *1* цементирующая добавка

centre *n. 2* центр; середина

center to center *10* межцентровое расстояние

century *n. 7* век, столетие

ceramics *n. C* керамика

compose *v. 3* составлять; компоновать
composite *a. 7* смешанный, составной, сложный
compound *a. 1* сложный; составной
compress *v. 1* сжимать
compression *n. 1* сжатие; прессование; компрессия; уплотнение
compressive *a. 1* сжимающий
compressive strength *1* сжимающее усилие; напряжение при сжатии
compressor *n. 5* компрессор
computer room *5* компьютерный зал
concave *a. 1* вогнутый
concentric scale *11* концентрическая шкала
conclude *v. 8* делать вывод; заключать
conclusion *n. 11* заключение; вывод
concrete *n. 1* бетон
condensation *n. 8* конденсация
condenser *n. 5* конденсатор
condition *n. 8* условие
conduct *n. 6* поведение
conduction *n. 8* проводимость, теплопроводимость
conductor *n. 1* проводник
cone *n. 1* конус
conflicting *a. 7* противоречивый
conical *a. 1* конический; конусный
connect *v. 3* соединять; связывать; подключать
connecting plate *3* соединительная плита/планка
consequently *adv. 6* следовательно
consider *v. 11* рассматривать
considerable *a. 7* значительный
considerably *adv. 7* значительно
consideration *n. 6* рассмотрение
consist of *v. 3* состоять из *чего-л.*
consolidation *n. 12* консолидация; укрепление
constant *n. 11* постоянная (величина); константа
constant *a. 5* постоянный
constraint *n. 7* ограничение; сдерживающий фактор; ограничивающее условие
construct *v. 3* строить; сооружать; создавать
construction *n. 6* строительство
contact *n. 3* контакт; соприкосновение
contain *v. 2* содержать в себе; вмещать
container *n. 12* контейнер; резервуар
contaminate *v. 12* загрязнять
content *n. 8* содержание
continue *v. 11* продолжать
continuous pipe *5* замкнутый контур
continuous process *6* постоянный процесс
contract *n. 6* подряд, контракт, договор
contract *v. 8* 1) сжимать(ся); стягивать(ся) 2) давать усадку
contraction *n. 8* 1) сжатие 2) усадка
contractor *n. 6* подрядчик
contrast *n. 12* противоположность; контраст
contribute *v. 11* способствовать, содействовать
control *v. 5* 1) контролировать 2) управлять
controller *n. 5* регулятор
convection *n. 8* конвекция
conversely *adv. 9* обратно; наоборот
convert *v. 10* преобразовывать; превращать
convex *a. 1* выпуклый
cool *v. 8* охлаждать
cool *a. 2* прохладный
cooling *n. 7* охлаждение
cooling coil *5* охлаждающий змеевик
cooling system *8* система охлаждения
copper *n. 1* медь
cork *n. 1* пробка
corner *n. 2* угол
corner unit *A* угловой узел; угловой блок
correct *v. 6* исправить; устранить
correction factor *11* поправочный коэффициент
correspond *v. 12* соответствовать
corridor *n. 10* коридор
corrode *v. 1* ржаветь
corrosion *n. 1* коррозия

ceramic tile *5* керамическая плитка
certain *a. 6* 1) определенный 2) некоторый
certainty *n. 10* определенность
chair *n. 4* стул
chance *n. 10* возможность; шанс
change *n. 6* изменение
channel *n. 1* 1) канал; желоб; паз 2) швеллер
cheap *a. 7* дешевый
check *n. 6* проверка
check *v. 11* проверять; контролировать
chemical *a. 8* химический
chemically *adv. 11* химически
chimney effect *10* 1) образование тяги; самотяга 2) эффект дымовой трубы
chimney stack *2* дымовая труба
chipping *s.pl. B* щебень
chisel *n. 11* долото, стамеска
choice *n. 7* выбор
choose *v.* **(chose, chosen)** *11* выбирать
chromium *n. 1* хром
church *n. 1* церковь
cinema *n. 5* кинотеатр
circle *n. 5* круг
circuit *n. 11* 1) цепь; контур 2) сеть
circular *a. 1* круглый
circulate *v. 5* 1) циркулировать 2) распространять(ся)
circulation *n. 8* циркуляция
cistern *n. 8* бак; цистерна; резервуар
city *n. 10* большой город
civilisation *n. 7* цивилизация
clad *v. 10* облицовывать
cladding *n. 3* 1) облицовка 2) плакирование 3) наружная обшивка *(стен здания)*
cladding fixer *6* панелеукладчик
cladding panel *6* панель облицовки
classroom *n. 4* классная комната
clay *n. 1* глина
clean *v. 5* чистить; протирать; очищать
cleaning *n. 5* чистка; очистка
cleaning material *1* чистящее, моющее средство
client *n. 2* клиент, заказчик
climate *n. 7* климат
climate zone *7* климатическая зона
climatic conditions *12* климатические условия
closing wall *9* стена заполнения каркаса
cloud cover *7* облачный покров; облачность
coarse *a. 4* 1) грубый 2) крупный, крупнозернистый
coarsely *adv. 12* грубо
coefficient of thermal conductivity *9* коэффициент теплопроводимости
coil *n. 12* 1) змеевик 2) спираль
cold *a. 7* холодный
cold *n. 9* холод
collapse *n. 8* разрушение
collapse *v. 10* рухнуть; разрушиться
collect *v. 8* собирать(ся); скопляться
collector *n. 12* коллектор; сборник
coloured *a. 12* окрашенный
column *n. 1* 1) колонна 2) колонка
column base *3* основание колонны
combination pliers *11* универсальные плоскогубцы
combine *v. 6* объединять(ся)
combustibility *n. 5* горючесть; способность гореть
combustible *a. 1* горючий
commerce *n. 5* торговля
commercial office *5* торговое учреждение
commission *n. 6* заказ
common *a. 4* 1) общий 2) распространенный
community *n. 10* община, сообщество
compact *a. 7* компактный; плотный
compare *v. 1* сравнивать
comparison *n. 9* сравнение
complete *v. 1* завершать; заканчивать
complete *a. 6* полный; законченный
completely *adv. 10* полностью
completion *n. 6* окончание; завершение
complicated *a. 12* сложный
component *n. 1* 1) узел; блок 2) компонент; составная часть

defects liability period *6* период устранения недоделок
define *v. C* определять
definite *a. 12* определенный
deflect *v. 8* прогибаться; провисать
deflection *n. 7* прогибание; прогиб; провес
deform *v. 1* деформировать
degree *n. 4* 1) градус 2) степень; ступень
degree Celsius *4* градус по шкале Цельсия
delay *v. 6* задерживаться
deliver *v. 6* доставлять
dense *a. 8* плотный
density *n. 4* плотность
dent *v. 1* вдавливать; оставлять след
department store *5* универсальный магазин; универмаг
dependent *a. 11* зависимый; зависящий
depend on *v. 8* зависеть от *чего-л.*
deposit *n. C* 1) отложение 2) осадок 3) накипь
deposit *v. C* откладывать(ся)
descale *v. C* удалять окалину, удалять накипь
descend *v. 8* опускаться
describe *v. 12* описать
description *n. 2* описание
design *v. 2* проектировать; конструировать; делать расчеты; чертить
designer *n. 6* дизайнер; конструктор; проектировщик; разработчик
desorption *n. 12* десорбция
destroy *v. 10* разрушать
destruction *n. 10* разрушение
detail *n. 6* подробность; деталь
detailing *n. 11* детальная съемка
deteriorate *v. 12* разрушаться; изнашиваться
determine *v. 2* 1) определять 2) обусловливать
device *n. 5* устройство; прибор; механизм
devise *v. 12* придумывать; изобретать
dew point *8* точка росы
diagonal *a. 1* диагональный
diagram *n. 1* диаграмма; схема
diameter *n. 1* диаметр
diamond-shaped *a. 1* ромбовидный
differ *v. 9* различаться; отличаться
difference *n. 8* разница
different *a. 9* различный; отличный
diffuse *v. 12* рассеивать *(свет)*
dimension *n. 4* размер; величина
dimensional *a. 12* размерный; пространственный
dining room *2* столовая
direct *a. 7* прямой; непосредственный
direct *v. 8* направлять
direction *n. 2* направление
directly *adv. 9* прямо; непосредственно
directly proportional *9* прямо пропорциональный
direct proportion *9* прямопропорциональность
direct solar radiation *7* прямая солнечная радиация
disadvantage *n. C* недостаток
discover *v. 12* узнавать; обнаруживать; раскрывать
discuss *v. 1* обсуждать
discussion *n. 1* обсуждение
dispensary *n. 5* амбулатория
displace *v. 8* вытеснять; замещать
dissolve *v. 8* растворять(ся); испарять(ся)
distance *n. 3* расстояние
distribute *v. 3* распределять(ся); размещать(ся); распространять(ся)
district *n. 5* район
divide *v. 1* делить; разделять
dome *n. 1* купол
domestic gas *n. 12* бытовой газ
doorway *n. 4* дверной проем
double *v. 7* удваивать
double glass door *A* двухстворчатая застекленная дверь
down pipe *2* 1) водосточная труба 2) спускная труба
drain *v. 8* 1) стекать 2) спускать *(воду)*
draught *n. 10* тяга; поток
draw *v.* **(drew, drawn)** *6* рисовать; чертить

corrosion resistance *1* коррозийная стойкость; сопротивление коррозии
corrosion resistant *1* коррозионностойкий
corrugated *a. 1* гофрированный; ребристый; рифленый
cost *n. 6* цена, стоимость
cost *v. 7* стоить
cost control *6* ценовой контроль; контроль стоимости
cost limit *6* лимитная цена
cost target *6* планируемый уровень издержек
counter *n. 12* 1) прилавок 2) счетчик
course *n. 11* горизонтальный ряд кладки
courtyard *n.* двор
cover *n. 4* 1) защитный слой бетона *(над арматурой)* 2) оболочка; покрытие; кожух
cover *v. 1* накрывать; покрывать
covered porch *2* крытое крыльцо
covering *n. 3* покрытие; настил
crack *n. 8* трещина
cracking *n. 8* образование трещин; растрескивание
crane *n. 1* кран
crops *n. pl. 10* урожай
cross-section *n. 1* поперечное сечение, профиль
cross ventilation *12* 1) поперечная (взаимовстречная) вентиляция 2) перекрестная вентиляция
crown *n. 3* замок арки свода
crush *v. 11* (раз)давить; дробить; размельчать
crushed marble *11* мраморная крошка
crushed stone *1* дробленый камень; щебень
C-shaped *a. 1* С-образный
cube *n. 1* куб
cubic *a. 4* кубический
cupboard *n. 2* кладовка; чулан
curve *n. 3* кривая *(линия)*, дуга
curved *a. 1* изогнутый; кривой; криволинейный
customer *n. 5* клиент; покупатель
cut *v.* **(cut, cut)** *2* отрезать; вырезать; разрезать
cut-away drawing *10* чертеж с вырезом; изображение с частным вырезом
cut-away view *2* изображение с частичным вырезом *или* разрезом
cutting *n. 11* резание
cyclone zone *10* зона циклонов
cylinder *n. 1* цилиндр
cylindrical *a. 1* цилиндрический

D

damage *n. 10* разрушение
damp *a. 8* влажный; сырой
dampness *n. 8* влажность; сырость
danger *n. 7* опасность
dangerous *a. 10* опасный
dark *a. 7* темный
data *n. pl. 8* данные
daylight *n. 11* естественное освещение; дневной свет
daylight factor *11* коэффициент естественной освещенности
daylight factor meter *11* счетчик естественной освещенности
dead load *10* масса конструкции; постоянная нагрузка; статическая нагрузка
deal with *v.* **(dealt, dealt)** *11* обходиться; поступать
death *n. 8* смерть
decibel *n. 4* децибел
decorate *v. 6* отделывать *(помещение)*
decoration *n. B* отделка; убранство; украшение
decorator *n. 6* отделочник; обойщик; декоратор
decrease *n. 8* уменьшение
decrease *v. 5* уменьшать(ся)
deduce *v. 10* выводить *(заключение, следствие)*
defect *v. 6* дефект; недоделка; изъян

evaporate *v. 12* испарять(ся)
evaporator *n. 5* испаритель
evaporator coil *12* змеевик испарителя
event *n. 6* событие
everywhere *adv. 12* всюду; везде
evolve *v. 12* 1) эволюционировать 2) развиваться
exact *a. 6* точный
exactly *adv. 10* точно
example *n. 1* пример
excavate *v. 6* копать; вынимать грунт; производить земляные работы
excavation *n. 6* выемка грунта; рытье котлована; земляные работы; экскаваторные работы
excavator *n. 6* экскаватор
exceed *v. 7* 1) превышать 2) превосходить
exception *n. 10* исключение
excess *n. 7* избыток; излишек
excessive *a. 7* излишний; чрезмерный
excessively *adv. 7* чрезмерно
exclude *v. 11* исключать
exert *v. 3* оказывать давление; вызывать напряжение
exhibit *v. 1* показывать; проявлять
exist *v. 10* существовать
exothermic *a. 12* экзотермический
expand *v. 5* расширять(ся)
expanded polystyrene *9* пенополистерол
expansion *n. 5* расширение
expansion tank *5* компенсационный бак; расширительный бак; компенсатор
expel *v. 12* вытеснять
expensive *a. 7* дорогой
experience *n. 10* опыт
experiment *n. 11* эксперимент
explain *v. 7* объяснять
explanation *n. 11* объяснение
expose *v. 2* выставлять; подвергать действию
exposed *a. 12* незащищенный; обнаженный; открытый
express *v. 4* выражать(ся)
expression *n. 9* выражение
extend *v. 2* удлинять; увеличивать(ся); вытягивать(ся); простирать(ся)
exterior *n. 2* внешняя сторона
external *a. 1* внешний; наружный
external envelope *5* внешняя оболочка
external surface *1* внешняя поверхность
extra *a. 6* дополнительный
extract *v. 12* извлекать
extreme *n. 12* крайность
extremely *adv. 10* чрезвычайно
eye *n. 4* глаз
eye level *12* уровень глаз

F

fabric *n. 6* здание без отделочных работ; остов; конструкция
facade *n. 1* фасад
face *n. 3* 1) лицо; лицевая сторона 2) торец; грань; фаска 3) фасад
face *v. 2* быть обращенным в определенную сторону
factor *n. 2* фактор
factor of safety *10* запас прочности; коэффициент безопасности
factory *n. 1* фабрика; завод
fail *v. 8* 1) ослабевать 2) разрушаться
failure *n. 8* разрушение; повреждение
fall *v.* **(fell, fallen)** *4* падать
fan *n. 5* вентилятор
fan motor *5* вентиляторный электродвигатель
fasten *v. 3* 1) зажимать; закреплять; свинчивать; скреплять 2) схватываться; затвердевать *(о строительном растворе)*
fault *n. 6* дефект; недоработка
feed tank *8* 1) питательный резервуар 2) расходный (рабочий) бак
feel *v.* **(felt, felt)** *12* чувствовать
felt *n. С* войлок; кровельный картон; рубероид
fibre *n. 1* волокно; фибра

drawing *n. 1* рисунок; чертеж
draw-off point *8* сливной кран; спускной кран
dried clay *1* сухая глина
drill *v. 11* сверлить
drilling *n. 11* сверление
drive *v.* **(drove, driven)** *12* управлять; приводить в действие
driver *n. 6* водитель; шофер
drum *n. 1* барабан
dry *v. 8* высыхать
dry *a. 5* сухой
dry rot *8* сухая гниль; червоточина
duct *n. 8* канал; проход; труба; проток
due to *pr. 7* благодаря
durability *n. 12* долговечность; срок службы; прочность; стойкость
dust *n. 5* пыль

E

earthy *n. 12* земля; почва; грунт
earthquake *n. 8* землетрясение
east *n. 2* восток
eaves *n. 12* карниз; свес крыши
economical *a. 7* экономичный
edge *n. 2* борт; край; кромка; бордюр
educate *v. 5* давать образование
effect *n. 8* 1) следствие; результат 2) действие; влияние
effective *a. 8* эффективный
efficiency *n. C* 1) эффективность 2) производительность 3) отдача; коэффициент полезного действия
elastic *a. 1* эластичный, упругий
elasticity *n. 1* упругость; эластичность
electrical equipment *6* электрооборудование
electric current *4* электрический ток
electrician *n. 6* электрик
electric wiring *6* электропроводка
element *n. 9* элемент *(конструкции);* компонент; *(составная)* часть
elevation *n. 2* фасад; вертикальная проекция
embed *v. 3* вставлять; встраивать; заглублять; заделывать; замоноличивать в бетон
emergency vehicle *10* 1) машина скорой помощи 2) пожарная машина
enable *v. 5* давать возможность
encase *v. 3* облицовывать; обшивать; опалубливать
enclose *v. 3* окружать; огораживать; заключать
enclosure *n. 5* оболочка; корпус *(здания)*
end *n. 3* 1) конец; край 2) торец; рабочее ребро
end wall *3* торцевая стена
engineer *n. 10* инженер
enlarge *v. 8* увеличивать
enormous *a. 8* огромный; громадный
enough *a. 7* достаточный
ensure *v. 7* обеспечивать; гарантировать
enter *v. 2* входить
entertain *v. 10* развлекать
entertainment centre *5* развлекательный центр
entrance *n. 2* вход
entrance hall *7* вестибюль
environment *n. 5* окружающая среда
equal *v. 4* равняться
equation *n. 4* уравнение
equator *n. 7* экватор
equivalent *n. 1* эквивалент
erect *v. 3* возводить; сооружать; устанавливать; монтировать; собирать
erector *n. 6* монтажник; сборщик
erode *v. 12* коррозировать; разрушать; разъедать
error *n. 8* ошибка; погрешность
escalator *n. 10* эскалатор
escape *v. 8* 1) уходить 2) бежать 3) спасаться 4) улетучиваться
escape route *10* запасной выход
essentially *adv. 12* по существу
estimate *n. 6* смета; расчет
estimate *v. 10* подсчитывать

foundation *n. 2* база; земляное полотно; фундамент; основание; постель
fraction *n. 11* 1) дробь 2) преломление; излом 3) разрыв 4) фракция
frame *n. 3* рама; рамка; корпус; каркас; остов
frame construction *1* каркасная конструкция
frequency *n. 10* 1) частота 2) периодичность
frequent *a. 8* частый
frequently *adv. 10* часто
fresh *a. 5* свежий
from inside *B* изнутри
front *n. 2* лицевая сторона; передняя сторона; фасад
front elevation *2* вид спереди; главный фасад
full *a. 6* полный
function *n. 1* 1) действие 2) назначение 3) функция
function *v. 5* действовать; функционировать
fundamental *a. 12* основной; существенный
furniture *n. 4* мебель

G

gain *v. 7* 1) извлекать пользу, выгоду 2) получать; приобретать
gallery *n. 8* галерея
gap *n. 8* зазор; просвет; промежуток; цель
garage *n. 2* гараж
gas *n. 1* газ
general *a. 12* общий, общего характера
generalisation *n. 10* обобщение
generally *adv. 10* обычно; как правило
gentle *a. 7* легкий; слабый
geographical area *10* географический район
germ *n. 5* микроб
germicidal treatment *5* антибактериальная обработка
Gio Ponti *A* Джо(ванни) Понти
girder *n. 7* балка, крупная составная балка; ферма; прогон; ригель
give *v.* **(gave, given)** *5* давать; отдавать
glare *n. 12* 1) ослепительный блеск; яркий свет 2) лоск, слепимость
glass *n. 1* стекло
glass fibre *1* стекловолокно
glass wool *1* стекловата
glazed *a. A* 1) остекленный 2) глазурованный
glazier *n. 6* стекольщик
glazing *n. 6* 1) остекление 2) стекольные работы
glue *n. 3* клей
glue *v. 3* клеить; приклеивать; склеивать
Golden Section, The *12* золотое сечение
go on strike *6* забастовать
gradually *adv. 12* постепенно
graph *n. 7* граф; график; номограмма; диаграмма; кривая
grass *n. 12* дерн; трава
gravel *n. 8* гравий
gravitational force *10* гравитация; сила тяжести
grid *n. 11* сетка; решетка
grill *n. B* 1) решетка; сетка 2) ростверк; оконная решетка
grit *n. 12* гравий; крупный песок; каменная мелочь; щебень
groove *n. 9* борозда; желоб; паз; канавка
ground *n. A* грунт; почва
ground floor *2* первый этаж; цокольный этаж
ground storey *2* бельэтаж
group *v. 5* 1) группироваться 2) классифицировать
grout *v. 3* заливать жидким строительным/ цементным раствором
guest *n. 10* гость
gutter *n. 2* 1) водосточная канава; сточная канава 2) водосточный желоб
gypsum plaster *1* гипсовый штукатурный раствор; сухая штукатурка

fibreboard *n. B* ДВП; древесноволокнистая плита; фибровый картон
fibre building board *1* ДВП; древесноволокнистая плита
field *n. 10* поле; область; пространство
fight (fought, fought) *v. 10* бороться; сражаться; воевать
figure *n. 10* 1) фигура 2) цифра 3) рисунок
file *n. C* напильник
file *v. 6* собирать; регистрировать
fill *v. 3* заполнять; наполнять(ся); закладывать; наливать; насыпать
filter *n. 5* фильтр
fin *n. 5* ребро
final *a. 6* окончательный
finally *adv. 6* в заключение; окончательно
find *v.* **(found, found)** *6* найти; находить
fine *a. 4* мелкий *(о песке)*
finger joint *12* пальцевой сустав
finish *n. 5* отделка
fin tube *5* ребристая труба; труба с ребрами- плавниками
fire *n. 5* 1) огонь 2) пожар
fire brigade *10* пожарная команда
fired clay *1* огнеупорная глина
fire door *1* пожарная перемычка/дверь
fire engine *10* пожарная машина
fire escape *10* пожарная лестница; пожарный выход
fireplace *n. 2* камин
fireproof *a. 1* огнестойкий; огнеупорный
fire resistance *5* огнестойкость, огнеупорность
fire station *5* пожарная станция
fit *v. 3* устанавливать; монтировать; собирать; пригонять
fix *v. 1* укреплять; устанавливать; фиксировать; закреплять
fixing plate *6* крепежная шайба
flashing *n. 12* фартук, гидроизоляция в местах примыкания строительных элементов
flat *a. 1* плоский
flexibility *n. 1* гибкость; упругость
flexible *a. 1* гибкий, эластичный
float *n. 11* 1) терка 2) поплавок
flooding *n. 10* наводнение
floor *n. 4* пол; настил; междуэтажное перекрытие; этаж
floor area *9* площадь пола
floor area of a building *9* общая площадь здания
floor beam *3* балка перекрытия
floor board *3* половица, доска
floor boarding *1* доска *(настила пола)*
floor finish *6* отделочное покрытие пола
floor frame *A* каркас пола
floor slab *6* 1) плита (панель) перекрытия 2) плита настила пола
flow *n. 4* 1) поток; сток 2) циркуляция в замкнутой системе
flow *v. 5* течь; вытекать; литься
flow diagram *6* схема последовательности операций; схема работы; схема технологического процесса; технологическая карта
flue *n. 2* дымовая труба; дымоход
flue gas *2* топочный (дымовой) газ
fluid *n. 12* жидкость
flush *a. 1* врезной; находящийся вровень; установленный заподлицо; утопленный
fly *v.* **(flew, flown)** *8* летать; улетать
foot *n.* (*pl.* **feet)** *12* 1) стопа 2) фут *(30,48 см)*
force *n. 3* сила; усилие
force *v. 10* вгонять; нагнетать
foreman *n. 6* мастер; прораб; бригадир
forever *adv. 10* 1) навсегда 2) постоянно
form *n. 7* форма; вид
form *v. 1* 1) придавать форму; принимать вид 2) создавать; формировать 3) формовать
formation *n. 8* образование
formless *a. 1* бесформенный
formula *n.* (*pl.* **formulae)** *11* формула
forward reach *4* расстояние вытянутой вперед руки

immerse *v. 11* погружать; окунать; затоплять
immersion *n. 12* иммерсия; погружение; оседание
immersion element *12* погружной элемент
Imperial Units *4* имперская система единиц
impermeable *a. 1* 1) герметичный 2) уплотняющий
impervious *a. 5* влагонепроницаемый
import *v. 12* импортировать; ввозить
importance *n. 7* 1) важность 2) значение
important *a. 7* важный; значительный
impossible *a. 10* невозможный
impractical *a. 9* непригодный; непрактичный
improbable *a. 10* невероятный
improve *v. 10* улучшать; совершенствовать
inadequate *a. 7* недостаточный; неподходящий; несоразмерный; неадекватный
inch *n. 12* дюйм *(2,5 см)*
inclined *a. 1* наклонный; отклоняющийся
include *v. 3* включать; заключать; содержать в себе
incoming *a. 8* поступающий
incorporate *v. 6* объединять; включать; присоединять
increase *n. 8* возрастание; повышение; прирост; увеличение
increase *v. 7* увеличивать; возрастать
indirect *a. 11* непрямой; косвенный
indirect light *11* 1) отраженный свет 2) косвенное освещение
industry *n. 5* 1) промышленность 2) отрасль промышленности
infant school *4* школа для малышей *(от 5 до 7 лет)*
infinitely *adv. 11* бесконечно; безгранично
influence *v. 2* влиять; воздействовать
information *n. 6* информация
in front of *pr. 2* перед, впереди
initially *adv. 6* первоначально
injure *v. 10* испортить; нанести травму; повредить
injury *n. 8* 1) повреждение 2) рана, ушиб
inner *a. B* внутренний
inorganic fibre *1* волокно неорганического происхождения
insect *n. 7* насекомое
I-shaped section *1* двутавровый профиль
inside *n. 2* внутренняя часть
inspection *n. 6* осмотр; инспектирование; надзор; контроль; проверка
install *v. 3* устанавливать; монтировать; собирать; возводить; размещать
installation *n. 6* установка; монтаж; размещение
instruction *n. 11* инструкция; директива; команда; обучение
instrument *n. 11* измерительный прибор; инструмент
insufficient *a. 7* недостаточный; неполный
insulant *n. C* изоляция; изоляционный материал
insulate *v. 8* изолировать
insulating material *9* изоляционный материал
insulation *n. 9* изоляция
intense *a. 9* сильный
intensity *n. 7* интенсивность; сила; энергия; напряженность
interact *v. 8* взаимодействовать
interaction *n. 8* взаимодействие
interior *n. 2* 1) внутренняя сторона 2) интерьер
intermediate zone *12* средняя полоса
intern *a. 1* внутренний
internal division *5* внутреннее разделение
internal sill *B* внутренний подоконник
interval *n. 6* промежуток; интервал
intruder *n. 5* незваный гость
invariably *adv. 10* неизменно; постоянно
invent *v. 12* изобретать
inversely proportional *9* обратно пропорциональный

H

hacksaw *n. 11* ножовка *(для металла)*
hailstorm *n. 10* ливень; гроза с градом; сильный град
hair *n. 1* волосы
hall *n. 2* холл; вестибюль; зал
handle *n. 1* ручка, рукоятка
hang *v.* **(hung, hung)** *3* вешать; висеть
hard *a. 1* твердый; прочный
hardcore *n. 8* трамбованный щебень
hardness *n. 11* твердость; прочность
hard water *C* жесткая вода
hardwood *n. 12* твердая древесина
hazard *n. 10* риск; фактор риска; опасность
head *n. B* верхний брус оконной/дверной коробки
head flashing *B* фартук верхнего бруса
heading *n. 11* заглавие; заголовок; рубрика
head tank *12* напорный бак
hear *v.* **(heard, heard)** *7* слышать
heat *n. 1* жар; степень нагрева; тепло; теплота
heat *v. 5* нагреть; обогревать
heat exchanger *12* теплообменник
heat flow *9* тепловой поток
heat gain *9* 1) теплоприток 2) теплопоглощение
heating *n. B* нагрев; нагревание; обогрев; обогревание; отопление
heating contractor *6* теплотехник
heating element *B* нагревательный элемент; термопара; термоэлемент
heating equipment *6* теплооборудование
heating system *8* система отопления
heat loss *9* потеря теплоты; теплопотери
heat storing material *7* теплоаккумуляционный материал
heat transfer *9* теплопередача
heavy *a. 1* тяжелый
height *n. 4* высота
hemisphere *n. 1* полушарие; полусфера
hemispherical *a. 1* полусферический
hessian *n. 1* джутовая мешочная ткань
hexagonal *a. A* шестиугольный
high *a. 5* высокий
high alumina cement *8* глиноземистый цемент
highly *adv. 10* очень; весьма; чрезвычайно
hold *v.* **(held, held)** *3* держать; удерживать; сдерживать
hole *n. 11* отверстие
hollow *a. 1* полый; пустой; пустотелый
horizontal *a. 3* горизонтальный
hospitable *a. 10* гостеприимный
hospital *n. 5* больница
hospital patients' room *5* больничная палата
hot *a. 2* горячий; теплый; жаркий
hot-water system *8* система водяного отопления
hotel *n. 1* гостиница
hotel guests' room *5* гостиничный номер
house *n. 5* дом
human body *12* человеческое тело
humid *a. 2* влажный
humidity *n. 7* влажность
hurricane *n. 10* ураган
hydraulic ram *11* гидроцилиндр
hygrometer *n. 11* гигрометр
hypothesis *n. (pl.* **hypotheses)** *11* гипотеза

I

icy *a. 10* покрытый льдом
ideal *n. 12* идеал
identical *a. 9* одинаковый; идентичный; тождественный
igloo *n. 9* иглу *(эскимосская хижина из затвердевшего снега)*
ignite *v. 10* воспламенять; зажигать
illumination *n. 4* освещение; освещенность

liable *a. C* подверженный
library *n. 5* библиотека
life span *12* 1) продолжительность жизни 2) срок службы
lift *v. 1* поднимать
lift shaft *10* шахта лифта
lift tower *A* лифтовая башня
light *n. 4* свет, освещение
light *a. 1* легкий
lighting engineer *11* инженер-электрик
lightning conductor *10* громоотвод; молниеотвод
likelihood *n. 10* вероятность
likely *a. 10* вероятный
lime *n. 1* известь
lime binder *1* известковый раствор
limit *n. 6* предел; лимит
limit *v. C* ограничивать, ставить предел
line *n. 10* линия
linear *a. 4* линейный
lining *n. B* тепло- *или* звукопоглощающая обшивка *(помещения)*
lining panel *B* облицовочная панель
link *v. 3* связывать; соединять; сцеплять
lintel *n. 3* кирпичная перемычка; дверная перемычка; оконная перемычка
liveable *a. 7* пригодный для жилья
live load *10* 1) временная полезная нагрузка 2) подвижная нагрузка
living room *2* гостиная
load *n. 1* груз; нагрузка
loadbearing wall *3* несущая стена
locally *adv. 12* в местном масштабе
locate *v. 3* располагать(ся); размещать(ся); устанавливать
location *n. 2* 1) местонахождение 2) участок
lock *v. 3* блокировать; запирать; стопорить
long *a. 2* длинный
longitude *n. 7* долгота
longitudinal *a. 1* продольный
longitudinal section *1* продольный разрез; продольный профиль
loop *n. 5* петля; бугель; контур; хомут
lose *v.* **(lost, lost)** *9* 1) терять 2) вызывать потерю
loss *n. 12* потеря; убыток; урон
louvre *n. 5* жалюзийное вытяжное отверстие; жалюзийное окно
low *a. 5* низкий
lower floor *5* нижний этаж
lower *v. 11* опускать
lower *a. 5* нижний
lozenge-shaped *a. 1* ромбовидный
L-shaped *a. 1* угловой; Г-образный
lumen *n. 4* люмен *(единица светового потока)*
luminous flux *4* световой поток
lump hammer *11* 1) ручной молот 2) киянка
lux *n. 4* люкс *(единица освещенности)*

M

machine *v. 3* обрабатывать на станке; подвергать механической обработке
machine tool *3* станок; металлорежущий станок
magnesium *n. 1* магний
magnitude *n. 10* абсолютное значение; величина; модуль вектора; порядок величины; размер
main *a. 2* главный; основной; магистральный
main *n. 8* магистральный водовод
maintain *v. 8* поддерживать; обслуживать; ремонтировать; эксплуатировать
maisonette *n. 5* 1) коттедж 2) двухэтажная квартира (квартира в двух уровнях); дуплекс
major *a. 7* главный; основной
majority *n. 12* большинство
make *v.* **(made, made)** *1* делать; изготовлять; производить
mallet *n. 11* деревянный молоток, киянка

inverse proportion *9* обратнопропорциональность
investigate *v. 11* исследовать
invite *v. 6* приглашать
inwards *adv. 2* внутрь
iron *n. 1* железо
irrigation ditch *2* оросительная канава
I-shaped *a. 1* двутавровый
item *n. 6* пункт; параграф; статья; отдельная операция

J

job *n. 6* работа; рабочее место; задание
join *v. 3* соединять; сращивать; наращивать; объединять; связывать
joiner *n. 6* столяр
joint *n. 3* 1) соединение 2) стык; шов; спайка; скрутка 3) узел
joist *n. 3* опорная балка; поперечная перекладина; ригель
joule *n. 4* джоуль
jug *n. 8* кувшин

K

keep *v.* **(kept, kept)** *5* держать; поддерживать; хранить; сохранять
kerosene *n. 12* керосин
keybrick *n. 3* замковый кирпич *(арки или свода)*
keystone *n. 3* замковый камень
k-value *n. C* коэффициент теплопроводности
kill *v. 10* убивать
kilogramme *n. 4* килограмм
kitchen *n. 2* кухня
kitchen sink *8* кухонная раковина
knob *n. 5* круглая ручка; шарообразная ручка
knocker *n. 2* дверной молоток
know *v.* **(knew, known)** *6* знать

L

laboratory *n. 5* лаборатория
labour *n. 6* работа; рабочая сила; рабочие кадры; труд
labour costs *B* стоимость рабочей силы
labourer *n. 6* рабочий
lack *n. 7* недостаток; отсутствие
last *v. 10* 1) продолжаться; длиться 2) сохраняться; выдерживать
lateral force *C* боковое усилие; горизонтальное усилие
lateral restraint *C* боковое защемление
latitude *n. 7* широта
lattice *n. 12* 1) решетка 2) оконный переплет
law *n. 7* закон; право
lay *v.* **(laid, laid)** *4* 1) класть; укладывать 2) накрывать; стелить
layer *n. 1* слой; пласт; уровень; ряд; настилка
layout *n. 3* 1) расположение 2) эскиз; проект 3) план; планировка
lead *n. 1* свинец
lead *v.* **(led, led)** *2* вести; проводить; вводить; выводить
leaf *n.* *(pl.* **leaves)** *12* лист
leak *n. C* неплотное соединение; течь
leather *n. 1* кожа
Le Corbusier *12* Ле Корбюзье
lecture room *5* лекционная аудитория
left *a. 2* левый
length *n. 2* длина
level *n. A* уровень
lever *n. 11* 1) рычаг; балансир; коромысло 2) рукоятка

movement *n.* *5* движение; перемещение; ход
mud *n.* *3* грязь; ил; иловая глина
mud brick *12* кирпич мокрой прессовки (формовки); глинобитный кирпич
mud house *9* дом-мазанка; глинобитный дом
mud wall *8* глинобитная стена
multiply *v.* *11* умножать
multi-storey building *10* многоэтажное здание

N

nail *n.* *3* гвоздь
nail *v.* *3* забивать гвозди; приколачивать; соединять на гвоздях
name *v.* *2* назвать
narrow *a.* *2* узкий; тесный
natural cause *8* естественная причина
natural disaster *10* природное бедствие
natural light *5* естественное освещение
natural stone *1* естественный камень; природный камень
navel *n.* *12* 1) пупок, пуп 2) центр, середина *(чего-л.)*
near *pr.* *2* около
nearly *adv.* *10* почти
network *n.* *8* сетка; сеть
newton *n.* *4* ньютон *(единица силы)*
nighttime *n.* *5* ночное время
noise *n.* *2* шум
noise level *5* уровень шума
nominal *a.* *11* именной; номинальный
nomogram *n.* *11* номограмма
non-combustible *a.* *1* невоспламеняющийся; негорючий
non-existent a. *10* несуществующий
north *n.* *2* север
note *n.* *11* примечание; сноска
note *v.* *11* 1) записывать 2) отмечать
notice *n.* *4* вывеска; объявление
number *n.* *6* 1) номер 2) количество 3) число 4) цифра
nut *n.* *11* гайка
nylon *n.* *1* нейлон

O

oak *n.* *7* дуб
object *n.* *5* предмет; вещь; объект
oblique *a.* *1* косой; наклонный
observation *n.* *10* 1) наблюдение 2) замечание
observe *v.* *10* 1) наблюдать 2) снимать показания прибора
obstruct *v.* *11* заграждать; заслонять; блокировать
obstruction *n.* *11* заграждение; препятствие, преграда
obtain *v.* *11* получать; достигать
occasionally *adv.* *10* изредка; время от времени
occupant *n.* *5* житель; жилец
occupy *v.* *2* занимать
occur *v.* *4* случаться; происходить; иметь место; встречаться
odour removal *5* дезодирование; уничтожение *(неприятного)* запаха
offer *v.* *6* предлагать; предложить
often *adv.* *10* часто
oil pipe *11* маслопровод
old people's home *5* дом для престарелых
opacity *n.* *1* непрозрачность
opaque *a.* *1* светонепроницаемый; матовый
opening *n.* *7* 1) отверстие 2) проем
open layout *7* открытая планировка
operate *v.* *8* работать; действовать; приводить в движение
opinion *n.* *12* мнение
opposite *a.* *2* противоположный
ordinary Portland cement *11* обычный портландцемент
orient *v.* *2* ориентировать

manual work *6* ручной труд; физический труд
manufacture *6* производство; изготовление: обработка
mark *v. В* отмечать; обозначать; метить; размечать
mass *n. 4* масса
mass construction *1* монолитная конструкция
material *n. 3* вещество; материал
mathematical *a. 7* математический
maximise *v. 2* доводить до максимума; максимизировать
maximum *a. 2* максимальный
mean *v.* **(meant, meant)** *6* 1) значить; означать 2) иметь в виду
mean altitude *11* средняя высота
means *n. 5* средство; метод; способ
measure *n. 4* 1) критерий; мера 2) измерение 3) показатель
measure *v. 4* измерять
measurement *n. 4* измерение; замер; контроль; размер
melting point *7* точка плавления; температура плавления
member *n. 3* деталь; элемент конструкции; звено
membrane *n. 1* 1) мембрана; диафрагма 2) изолирующее покрытие
merit *n. 6* достоинство; качество
metal *n. 1* металл
method *n. 5* метод; система; прием; способ; технология
metre *n. 3* метр
metric system *12* метрическая система
micro-wave tower *9* микроволновая башня
Mies van der Rohe *A* Людвиг Мис Ван Дер Роэ
mild steel *7* мягкая (низкоуглеродистая) сталь
millimetre *n. 4* миллиметр
minaret *n. 1* минарет
mineral wool *5* шлаковая *или* минеральная вата
minimise *v. 2* доводить до минимума; минимизировать
minimum *a. 2* минимальный
mistake *n. 10* ошибка; погрешность; просчет
mix *n. 11* агломерат; смесь; состав смеси; шихта
mix *v. 5* перемешивать; смешивать; приготавливать смесь
mixing *n. 5* перемешивание; смешивание
modify *v. 5* модифицировать; видоизменять
model *n. 6* макет; модель; образец; шаблон
Modulor *n. 1* Модулор *(система пропорционирования элементов здания, созданная Ле Корбюзье на основе пропорций средне-стандартной мужской фигуры и описанная им в 1951 г. в книге 'Le Modulor')*
moisture *n. 1* влага; влажность; сырость
moisture barrier *5* влагоизоляция; гидроизоляция
moisture content *8* влагосодержание; содержание влаги
moisture laden air *8* влагонесущий (влажный) воздух
monolithic dwelling *7* монолитное жилое здание
monsoon climate *7* муссонный климат
mortar *n. 3* строительный раствор
mortar bed *3* 1) слой раствора; подушка из раствора 2) творило
mortise-and-tenon joint *11* соединение шипом в гнездо
mosque *n. 1* мечеть
motel *n. 5* мотель
mould *n. 11* 1) лепное украшение 2) опалубка 3) изложница; литейная форма 4) плесневый гриб
mould growth *8* образование плесени
movable *a. 10* переносной; подвижной; разборный
move *v. 8* двигать(ся); передвигать; перемещать; транспортировать

permeability *n. 11* проницаемость
permeable *a. 1* проницаемый; негерметичный
permit *v. 7* допускать; позволять
perpendicular *a. 2* перпендикулярный
pervious *a. 5* пропускающий *(влагу и т.п.)*
phase *n. 6* фаза; период; стадия; этап
pincers *n. pl. 11* клещи
pine *n. 7* сосна; сосновая древесина
pipe *n. 1* труба, трубопровод
pipework *n. 6* система трубопроводов
pitch *n. 7* 1) вар; деготь; смола 2) наклон; уклон 3) угол наклона
place *v. 2* помещать; размещать; ставить; укладывать
plain a. *C* гладкий; простой; плоский; неармированный; ровный
plan *n. 2* план
planar construction *1* планарная конструкция
plane *n. 3* 1) плоскость 2) рубанок
plank *n. 3* 1) планка 2) доска *(толщиной 5—10 см и шириной 20 см)*
plaster *n. C* штукатурка
plasterboard *n.* C 1) гипсовый картон 2) лист сухой штукатурки
plasterer *n. 11* штукатур
plastic *n. 1* пластмасса, пластик
plastic *a. 1* пластический; пластичный
plasticity *n. 1* пластичность
plate *n. 3* пластина; плита; лист; плата
pleasant *a. 12* приятный
pliers *n. pl. 11* клещи
plumb-bob *n. 11* отвес
plumber *n. 6* слесарь-водопроводчик
point *n. 7* точка
point of view *7* точка зрения
pollution *n. 5* загрязнение
pollution free *5* незагрязненный; незагрязняющий
polythene *n. 1* полиэтилен
polyurethane foam *C* пенополиуритан
poor *a. C* бедный; недостаточный; слабый
poor quality *8* низкое качество
porch *n. 2* 1) портик; крытая галерея 2) подъезд; крыльцо
porous *a. 8* пористый
portable *a. 10* портативный; переносной; передвижной; разборный
portion *n. 11* часть; доля; блок; узел
position *n. 3* положение; позиция; расположение
possess *v. 1* обладать
possession *n. 1* владение
possible *a. 7* возможный
post-and-lintel (construction) *3* стоечно-балочная конструкция
post office *5* почта
power circuit *11* силовая цепь; сеть питания; сеть электроснабжения
power drill *11* электрическая дрель
power station *1* электростанция
power supply *10* энергоснабжение; источник питания
practical *a. 9* полезный; практический; целесообразный
precast concrete *3* сборный бетон
precaution *n. 10* предосторожность; мера предосторожности
precede *v. 6* предшествовать
precipitation *n. 5* атмосферные осадки
pre-cut slot *B* врубовая щель; щелевое отверстие
predict *v. 10* предсказывать
predictable *a. 10* предсказуемый
prefabricated building *6* здание из сборных элементов; сборное здание
preliminary *a. 6* подготовительный; предварительный; черновой
preparation *n. 6* подготовка
prepare *v. 11* приготавливать(ся)
presence *n. 8* 1) наличие 2) присутствие
preservative *n. 10* 1) консервант 2) противостаритель
preservative stain *12* предохранительная протрава от старения *(для древесины)*
pressure *n. 5* давление; напор; сжатие
pressure gauge *11* манометр

orientation *n. 2* ориентация; ориентирование
outer *a. B* внешний
outer sheathing *11* внешняя оболочка; внешняя оплетка
outer space *7* космическое пространство
outlet *n. 8* 1) выпускное отверстие 2) исток; сток; выход
outlet pipe *5* выпускная труба
outside *n. 2* наружная сторона
outskirts *n. pl. 5* окраина; предместье *(города)*
outwards *adv. 2* наружу
oven *n. 2* печь
over *pr. 2* над
overall *a. C* полный; общий
overcast *a. 12* покрытый облаками; мрачный; хмурый *(о небе)*
overcome *v.* **(overcame, overcome)** *12* побороть; преодолеть
overhanging eaves *12* нависающий карниз, свес крыши
overhead *a. 7* верхний; надземный
overheat *v. C* перегревать(ся)
overlook *v. 12* выходить на, в
overturning *n. 9* опрокидывание
owing to *pr. 8* по причине; благодаря; вследствие
ownership *n. 6* владение; собственность; право собственности

P

packaged air conditioning unit *5* 1) компактный *(портативный)* кондиционер 2) агрегатированный кондиционер
packing *n. 3* набивка; прокладка; уплотнение; заполнение *(пустот)*
paint *n. 8* краска; окраска
paint *v. 8* красить; окрашивать
painting *n. 8* окрашивание; окраска
pair *n. 10* пара
palace *n. 7* дворец
palm-frond *n. 12* лист пальмы
panel *n. 1* панель; плита; филенка; щит
panel saw *11* ленточная пила
paper *n. 1* бумага
paraffin *n. 12* 1) парафин 2) керосин
parallel *a. 2* параллельный
parapet *n. 4* балюстрада; бруствер; парапет
partition *n. 5* 1) перегородка 2) ненесущая внутренняя стена
partly *adv. 12* частично
party wall *8* общая стена двух прилегающих зданий; простенок
pass *v. 1* проходить; пропускать
passage *n. 5* галерея; коридор; проезд; проход; прохождение
past *pr. B* мимо
past experience прошлый опыт
patch *n. 8* 1) лоскут 2) пятно неправильной формы
path *n. 2* путь; дорожка
pave *v. A* мостить; укладывать дорожное покрытие
pay *v.* **(paid, paid)** *6* платить
pedestrian access *2* пешеходный подход
penetrate *v. 10* проникать; пронизывать; пропитывать
people *n. pl. 12* люди
per cent *11* процент
percentage *n. 11* процент; процентное отношение; процентное содержание
perform *v. 5* выполнять; делать; производить
performance *n. 9* эксплуатационные характеристики; производительность
performance requirements *4* 1) требования к (рабочим) характеристикам 2) нормы и правила *(технологии выполнения строительных работ)*
perimeter *n. 2* длина окружности; периметр
period *n. 6* период; промежуток; цикл
periodic *a. 6* периодический; циклический

rainwater pipe *B* водосточная труба
raise *v. A* 1) поднимать; сооружать 2) возводить
ram *n. 11* плунжер насоса
range *n. 12* 1) ряд 2) предел 3) диапазон
range *v. 4* колебаться в пределах
rapid-hardening cement *11* быстротвердеющий цемент
rapidly *adv. 5* быстро
rarely *adv. 10* редко, нечасто
rate *n. 4* 1) норма 2) степень 3) разряд 4) темп 5) величина; расход
ratio *n. 9* 1) отношение; соотношение; пропорция 2) коэффициент; степень
rational *a. 12* рациональный
ray *n. 8* луч *(солнца)*
reach *v. 5* достигать; доставать
reaction *n. 8* реакция
read *v.* **(read, read)** *7* 1) читать 2) считывать; снимать показания прибора
reading *n. 11* показание *(прибора);* считывание
rear *n. 2* задняя/тыльная сторона
reason *n. 3* причина; основание; довод
receive *v. 6* получать; принимать
recessed *a. 1* имеющий вырез; углубленный; утопленный
reciprocal *n. C* обратная величина
record *v. 10* регистрировать; записывать
recording *n. 11* запись
recreation *n. 5* отдых
rectangle *n. A* прямоугольник
rectangular prism *1* прямоугольная призма
reduce *v. 7* понижать; уменьшать; ослаблять; сокрашать
reduction *n. 11* понижение; уменьшение; ослабление; сокращение
refer to *v. 11* ссылаться на *что-л.*
reflectance *n. 11* коэффициент отражения; отражательная способность
reflected light *11* отраженный свет
reflection *n. 11* отражение
reflection coefficient *11* коэффициент отражения
refrigerant *n. 12* охладитель; хладагент
regard *n. 7* отношение
region *n. 7* район; регион; зона
regular *a. 6* нормальный; регулярный; правильный; систематический
reinforced concrete *4* железобетон
reinforcement *n. 4* 1) арматура *(железобетона)* 2) армирование; усиление; укрепление
reject *v. 12* 1) отвергать 2) отторгать
relate *v. 12* соотносить
relation *n. 9* отношение; соотношение; зависимость
relative *a. 5* относительный
relative humidity *5* относительная влажность *(воздуха)*
relatively *adv. 9* относительно
release *v. 8* выпускать; выделять
relieve *v. 5* уменьшать; ослаблять
religion *n. 5* религия
removable *a. C* съемный; переносной; сменный
remove *v. 2* 1) перемещать 2) удалять
repair work *12* ремонтные работы
replace *v. 8* заменять; замещать
represent *v. 7* 1) представлять 2) означать
require *v. 4* требовать(ся)
requirement *n. 2* требование
reradiate *v. 7* излучать в обратном направлении
reservoir *n. 8* бассейн; водоем; резервуар
residential area *5* жилой район
residential building *4* жилой дом
resist *v. 1* сопротивляться; противостоять
resistance *n. C* сопротивление; противодействие; стойкость; устойчивость
responsibility *n. 10* 1) ответственность 2) обязанности; обязательства
responsible *a. 6* ответственный
rest *v. 3* покоиться
restaurant *n. 5* ресторан
result *n. 11* 1) результат; следствие 2) итог
result in *v. 12* кончаться; иметь результатом

pressure scale *11* шкала давления
pressurise *v. 10* герметизировать
prevailing wind *8* господствующий ветер
prevent *v. 1* предотвращать; предохранять
price *n. 6* стоимость; цена
price *v. 6* оценивать; назначать цену
primarily *adv. 7* первоначально
primary *a. 8* первоначальный; первичный; основной
primary flow *12* прямой стояк
primary return *12* обратный стояк, «обратка»
prism *n. 1* призма
prismatic *a. 1* призматический
privacy *n. 5* уединение; уединенность
probability *n. 10* вероятность
probable *a. 10* вероятный
problem *n. 4* проблема; задача; задание
procedure *n. 11* процедура; технологический процесс; порядок действия
proceed *v. 6* продолжать(ся); возобновлять, делать *(после перерыва)*
process *n. 8* процесс; прием; режим; способ
production *n. 6* производство; изготовление; продукция
profiled *a. 3* профильный; профилированный
progress *v. 11* прогрессировать; развиваться
project *v. 11* 1) проектировать 2) выдаваться; выступать 3) бросать, отражать *(луч света)*
projecting *a. 1* выдающийся; выступающий; консольный
properly *adv. 11* должным образом; как следует; правильно
property *n. 1* 1) свойство; качество; характеристика 2) имущество; собственность
proportion *n. 9* 1) пропорция 2) соотношение
proportional *a. 11* пропорциональный
proportionately *adv. 9* соразмерно; пропорционально
protect *v. 2* защищать; охранять; предохранять
protection *n. 7* блокировка; защита; предохранение
protractor *n. 11* угломер; транспортир
provide *v. 5* обеспечивать; предоставлять
published tables *11* печатные таблицы
pump *n. 5* насос
pump *v. 12* качать; откачивать
purpose *n. 5* цель; назначение; намерение
put *v.* **(put, put)** *6* класть; помещать
put out *v. 10* тушить *(огонь)*
pyramid *n. 1* пирамида
pyramidal *a. 1* пирамидальный

Q

quality *n. 7* качество
quality control check *11* контроль/проверка качества
quantity *n. 6* количество
quantity surveyor *6* нормировщик
quarter *n. 4* четверть

R

radiant *a. 12* 1) светящийся, излучающий свет 2) сияющий, лучистый
radiate *v. 7* излучать, испускать лучи
radiation *n. 12* излучение; радиация; лучеиспускание
radiator *n. 5* радиатор; батарея отопления
railway line *2* железнодорожный путь
railway station *5* железнодорожная станция
rain *n. 7* дождь
rainfall *n. 7* 1) атмосферные осадки 2) количество атмосферных осадков

select *v.* *6* выбирать; отбирать; сортировать
self-closing *a.* *10* самозакрывающийся; самозамыкающийся
self-employed *a.* *10* работающий не по найму
semi-circle *n.* *1* полукруг
semi-circular *a.* *1* полукруглый
send *v.* **(sent, sent)** *6* послать; посылать
separate *v.* *5* разделять; отделять; сортировать
separate *a.* *2* отдельный; разъединенный
separately *adv.* *11* отдельно
separation *n.* *12* 1) отделение; разделение; сепарация 2) разложение на части
sequence *n.* *6* последовательность; чередование; порядок *(следования)*
serve *v.* *5* служить
services *n. pl.* *6* коммуникации; инженерное оборудование здания
set *n.* *12* набор; комплект
set *v.* **(set, set)** *A* устанавливать; крепить; закреплять; монтировать
shade *n.* *7* тень
shaded *a.* *12* тенистый
shake *v.* **(shook, shaken)** *8* трясти; встряхивать
shape *n.* *1* форма; вид; профиль
shape *v.* *1* придавать форму
sharp *a.* *12* 1) острый 2) резкий 3) крутой
shear strength *1* прочность на сдвиг; сопротивление сдвигу; сопротивление скалыванию
sheathing *n.* *11* оболочка; оплетка; кожух
sheet *n.* *1* лист; листовой материал
shell structure *1* конструкция-оболочка
shelter *n.* *7* 1) кров; убежище 2) сарай
shine *v.* **(shone, shone)** *8* светить(ся); сиять; блестеть
shop *n.* *5* магазин
shore *n.* *A* берег; побережье
shortage *n.* *12* дефицит; нехватка
shoulder *n.* *4* плечо
shovel *n.* *11* совковая лопата
show *v.* **(showed, shown)** *3* показывать
shut *v.* **(shut, shut)** *5* закрывать; затворять; запирать
shutter *n.* *2* ставень; жалюзи
SI Units *n. pl.* *4* Международная система метрических единиц
side *n.* *2* бок; сторона; край
sideways force *3* боковое усилие
sideways reach *4* расстояние вытянутых в сторону рук
sign *v.* *6* подписывать; отмечать
significantly *adv.* *10* значительно
similar *a.* *11* похожий; подобный; сходный; аналогичный
similarly *adv.* *9* так же, подобным образом
simultaneously *adv.* *6* одновременно
sill *n.* наружный подоконник; подушка *(оконной рамы)*; сливная доска окна
silver *n.* *1* серебро
single-storey house *2* одноэтажный дом
sink (sank, sunk) *v.* *8* опускать(ся); оседать
sink unit *4* кухонная раковина
site *n.* *6* площадка; участок
situated *p. p.* *2* расположенный
situation *n.* *4* ситуация; обстановка; положение
size *n.* *4* величина; размер; формат
sketch *n.* *1* эскиз; набросок; чертеж
skeleton *n.* *3* каркас; остов; скелет
skeleton structure *A* каркасная конструкция
sketch plan *7* эскизный план; кроки
skin *n.* *8* оболочка; покрытие; облицовка; обшивка
skirting *n.* *B* 1) окаймление 2) плинтус
sky *n.* *11* небо
sky component *11* коэффициент естественной освещенности
slab *n.* *1* плита
slenderness ratio *9* гибкость *(при продольном изгибе)*
slight *a.* *10* незначительный; слабый
slightly *a.* *7* слегка; немного

retain *v. 7* 1) удерживать 2) сохранять
retention *n. 9* сохранение; удержание
return *n. 8* 1) возврат 2) обратная труба
return line *5* обратный трубопровод; обратная линия
revision *n. A* повторение
rib *n. 4* ребро; выступ
right *a. 2* правый
right angle *9* прямой угол
rigid *a. 1* жесткий; неизменный; устойчивый
rigidity *n. 1* жесткость
rise *v.* **(rose, risen)** *1* возрастать; подниматься
risk *n. 10* риск; опасность
risk factor *10* фактор риска
rivet *n. 3* заклепка
rivet *v. 3* заклепывать; клепать
road *n. 2* дорога
rock *n. 10* скала; горная порода
rod *n. 1* стержень; прут; брус; рейка
roll *n. 1* вал; валик; ролик; рулон
rolled metal *1* прокатанный металл; прокат
roller shutter *10* подъемный ставень; свертывающаяся штора
roll up *v. 12* свертывать; завертывать
roof beam *3* стропильный ригель
roof covering *6* кровля; кровельный материал
roof decking *6* настил крыши
roof frame *A* стропильная ферма
roofing contractor *6* кровельщик
roof timbers *A* стропила
room *n. 2* комната; помещение; пространство
rough *a. 3* 1) грубый 2) необработанный
rubber *n. 1* каучук; резина
ruler *n. 4* линейка
run *v.* **(ran, run)** *5* тянуться; проходить; простираться
rural *a. 10* сельский; деревенский
rush hour *4* час пик
rusty *a. 1* ржавый; заржавелый

S

safe *a. 5* безопасный; надежный
safety factor *10* запас прочности; коэффициент безопасности
safety valve *5* предохранительный клапан
salt *n. 8* соль
sand *n. 1* песок
sandstorm *n. 10* самум; песчаная буря
sanitary fittings *6* санитарное оборудование
scaffolding *n. B* 1) возведение строительных лесов 2) строительные леса
scale *n. 4* 1) накипь; окалина 2) шкала; масштаб
scaling *n. C* образование окалины/накипи
schedule *n. 6* план; расписание; график
school *n. 5* школа
scratch *v. 1* царапать
screen *n. 6* 1) экран; решетка; ограждение 2) сетка на окне
screen *v. 7* прикрывать; защищать
screening *n. 7* ограждение
screw *n. 11* винт; шуруп
screwdriver *n. 11* отвертка
seasonal variation *7* сезонное колебание
seat *n. 4* сиденье
second *n. 4* секунда
section *n. 1* разрез; профиль; сегмент; часть
sectional *a. 4* поперечный; составной
secure *v. 3* 1) закреплять; крепить; соединять 2) обеспечивать
security *n. 5* 1) безопасность 2) защита; охрана
segment *n. 3* отрезок; сегмент; часть; участок; сектор
segmental arch *3* сегментная арка; лучковая арка
seismic area *10* сейсмическая зона
seldom *adv. 10* редко

stain *n. 8* 1) пятно 2) краситель 3) протравка
stainless steel *1* нержавеющая сталь
staircase *n. 2* лестница; лестничная клетка
stairs *n. pl. 2* лестница
stanchion *n. 1* стойка, колонна, столб, подпорка
stanchion casing *B* опалубка (кожух) стойки
standard *n. 11* стандарт, норма, образец
start *v. 5* начинать; запускать; пускать в ход; стартовать
starting point *12* точка отсчета; исходная позиция
statistics *n. 10* статистика
steel *n. 1* сталь
steel mould *11* стальная литейная форма; изложница
steel tape *11* стальная рулетка
steelwork *n. 6* 1) стальные изделия 2) стальная конструкция
steep *a. 7* крутой; отвесный
stick *v. 11* прикреплять; наклеивать
stone *n. 1* камень
storage *n. 8* 1) склад 2) хранение 3) накопление 4) водные запасы
storage cylinder *8* аккумуляторный цилиндр
store *v. 5* хранить; складировать; запасать; накапливать
storey *n. A* этаж; ярус
straight *a. 3* прямой; прямолинейный
strain *n. 8* деформация, натяжение
strain gauge *11* тензодатчик; тензометр; прибор для измерения деформаций
strand *n. 11* пучок *(многожильного кабеля);* стренга; прядь; жила
strength *n. 5* прочность; сила; крепость
strengthen *v. 8* укреплять; упрочнять; усиливать
stress *n. 8* напряжение; напряженное состояние
stressed-skin structure *1* бескаркасное жесткое сооружение; преднапряженная конструкция типа оболочки
stretch *v. 1* 1) растягивать 2) вытягивать
strictly *adv. 11* строго
stride *n. 12* большой шаг
strike a balance *7* подводить итог; свести к единому целому
strip *n. 1* рейка; планка; полоса; брусок
structural concrete *A* конструкционный бетон
structural damage *10* разрушение конструкции
structural engineer *11* инженер-строитель
structural failure *8* конструктивная ошибка
structure *n. 1* конструкция; сооружение; строение; структура
study *n. 2* кабинет
subdivide *v. 12* подразделять
subjected to *p. p. 8* подвергаемый воздействию
submit *v. 6* представлять на рассмотрение
subsequently *adv. 6* впоследствии; потом; позже
subsided *a. 8* осевший
subsidence *n. 8* 1) оседание 2) осадка
subtend *v. 11* стягивать *(дугу);* противолежать
subtract *v. 11* вычитать
subtropical *a. 12* субтропический
suburban *a. 5* пригородный
sufficient *a. 7* достаточный
sufficiently *adv. 12* достаточно
suggest *v. 6* предлагать
suitable *a. 5* годный; подходящий; соответствующий
sunlight *n. 7* солнечный свет
sunshine *n. 10* солнечный свет
sun protection *7* солнцезащита
superimpose *v. 11* накладывать
supervision *n. 6* надзор; наблюдение; контроль
supply *n. 6* поставка; снабжение; запас
support *n. 9* несущая конструкция; опора; опорная стойка
support *v. 1* поддерживать; нести; подпирать

slip *v. 10* скользить; поскользнуться
slit window *12* окно-прорезь; щелевое окно
sloping *a. 1* наклонный; покатый; отлогий
slot *n. B* паз; гнездо; желобок; канавка
smoke *n. 10* дым
smooth *v. 11* 1) выравнивать; разглаживать; сглаживать 2) шлифовать; доводить; выполнять чистовую обработку
snow *n. 5* снег
social organisation *7* общественная организация
society *n. 10* общество
soffit *n. 2* кессон потолка; нижняя поверхность плиты перекрытия; софит
soft *a. 1* мягкий; гибкий; пластичный
softness *n. 1* мягкость
soft steel *1* мягкая сталь; малоуглеродистая сталь
soft water *C* мягкая вода
softwood *n. 12* древесина мягкой породы
soil *n. 8* грунт; земля; почва
solar *a. 12* солнечный
solar collector *12* солнечный коллектор
solar energy *12* солнечная энергия
solar radiation *12* солнечная радиация, солнечное излучение
solid *a. 1* цельный; сплошной; твердый; массивный; объемный
solid angle *11* телесный угол; объемный угол
soluble *a. 8* растворимый
soluble sulphates *8* растворимые сульфаты
solution *n. 4* 1) решение 2) раствор
solve *v. 7* решать; разрешать *(проблему)*
sometimes *adv. 10* иногда
sound insulation *5* звукоизоляция
sound insulator *5* звукоизолятор
sound pressure *11* интенсивность шумов
sound pressure meter *11* шумомер; измеритель интенсивности шумов
sound transmission *5* звуконепроницаемость
source *n. 11* источник
south *n. 2* юг
space *n. 2* 1) пространство 2) место; расстояние; промежуток; интервал
space *v. 3* располагать; расставлять с промежутками
space divider *5* разделитель пространства
space structure *1* пространственная структура
spalling *n. 4* выкрашивание; откалывание; растрескивание
span *n. 3* пролет; расстояние между опорами
span *v. 3* перекрывать *(аркой, сводом)*
spanner *n. 11* гаечный ключ
spatial *a. 4* пространственный
specific *a. 12* определенный; конкретный; особый
specification *n. 6* спецификация; технические условия; техническое описание
specify *v. 6* 1) точно определять; задавать *(параметры)* 2) указывать; устанавливать
specimen *n. 11* образец; пробный экземпляр
speed *n. C* скорость
sphere *n. 9* сфера; шар
spirit level *11* спиртовой уровень; ватерпас; нивелир
split *n. 12* продольная трещина *(в древесине)*
spread *v.* **(spread, spread)** *5* 1) распространять(ся); простираться 2) укладывать *(бетонную смесь)*
springing line *3* линия пят арки
square *n. 1* 1) квадрат 2) угольник
squareness *n. 11* перпендикулярность *(сторон)*
stabilise *v. 8* стабилизировать; делать устойчивым
stability *n. C* устойчивость, состояние равновесия
stable *n. 2* конюшня
stable *a. C* устойчивый; стойкий
stage *n. 6* стадия; этап; ступень; фаза

thigh *n. 4* бедро
thin *a. 1* тонкий; редкий; разжиженный
think *v.* **(thought, thought)** *12* думать
three-dimensional *a. 1* трехмерный; объемный; пространственный
throttle valve *n. 12* дроссельный клапан, дроссель
throughout *pr. 7* в продолжение
thunderstorm *n. 10* гроза
tie *v. 3* связывать; скреплять
tie beam *3* поперечина; траверса; затяжка; анкерная балка; балка перекрытия
tighten *v. 11* затягивать; подтягивать
tile *n. 1* плитка; черепица
timber *n. 3* древесина; пиломатериал
time *n. 7* 1) время 2) раз
tin *n. 1* олово
toilet *n. 2* туалет; санузел
ton *n. 7* тонна
tongue *n. 9* шпунт
tongued and grooved (joint) *C* шпунтовое соединение
tool *n. 4* рабочий инструмент
top *n. 1* вершина, верх; верхний край
total *a. 4* общий; полный; суммарный; итоговый
tower *n. 8* башня; вышка
trabeated *a. 3* перекрытое балкой
trace *v. 11* 1) набрасывать; чертить 2) снимать копию; калькировать
tracing *n. 11* 1) калькирование; копирование на кальке *или* восковке 2) калька; копия
trade *n. 6* 1) производство; кустарный промысел 2) профессия
tradesman *n.* (*pl.* **tradesmen**) *6* ремесленник; производственник
traditional *a. 12* традиционный; передаваемый из поколения в поколение; обычный; привычный
traffic *n. 5* дорожное/уличное движение
train *n. 4* поезд
transfer *v. 1* переносить; переводить; передавать; перемещать
transmit *v. 1* передавать; проводить; посылать; пропускать
transparency *n. 1* прозрачность; проницаемость
transparent *a. 1* прозрачный; проницаемый
transport *n. 5* транспорт
transverse section *2* поперечное сечение; поперечный профиль
treat *v. 5* 1) лечить 2) обрабатывать
treatment room *5* лечебный кабинет
triangle *n. 1* треугольник
triangular *a. 1* треугольный; трехгранный
tropical *a. 7* тропический
tropic of Cancer *7* тропик Рака
tropic of Capricorn *7* тропик Козерога
trouble *n. C* проблема; неисправность; повреждение; авария; нарушение технологического процесса
trowel *n. 11* мастерок
truss *n. 7* висячая стропильная конструкция; ферма
T-shaped *a. 1* Т-образный; с тавровым профилем
tube *n. 1* труба
turn *v. 11* 1) вращать 2) поворачивать 3) закручивать 4) преобразовывать
turn on *v. 5* 1) включать 2) открывать *(кран)*
turn off *v. 5* 1) выключать 2) закрывать *(кран)*
twist *v. 11* крутить; скручивать; закручивать
type *n. 5* тип; образец; класс; род; система
typical *a. 7* типичный; типовой
typically *adv. 12* типично

U

uncertainty *n. 10* неопределенность; ненадежность
uncomfortable *a. 4* неудобный
under *pr. 2* под

supported structure *1* несомая конструкция; подпорная конструкция
supporting *a. 9* вспомогательный; опорный; несущий
supporting strength *9* опорная прочность
surface *n. 1* поверхность; плоскость; покрытие
surface area *9* площадь поверхности
surround *v. 3* обступать; окружать
surrounding *a. 12* близлежащий, соседний; окружающий
survey *n. 10* 1) обследование 2) опрос
suspended ceiling *5* подвесной потолок
suspended floor *5* навесной пол
swimming pool *5* плавательный бассейн
switch *n. 5* выключатель
switch *v. 5* переключать; включать; выключать
symbol *n. 12* символ; знак; условное обозначение
system *n. 8* система; установка; устройство

T

table *n. 1* 1) стол 2) таблица
take *v.* **(took, taken)** *10* 1) брать 2) принимать
tall *a. 4* высокий
tank *n. 8* 1) бак; цистерна 2) резервуар
tapering *a. A* конический; конусообразный; суживающийся
tar *n. 1* гудрон; смола
team *n. 10* команда; бригада
telephone *n. B* телефон
temperate zone *12* умеренная полоса *(климата)*
temperature *n. 4* температура
temperature control *5* регулирование температуры
temperature difference *9* разность температур
temperature gradient *9* температурный градиент
temple *n. 7* храм
tend *v. 10* 1) иметь тенденцию 2) иметь склонность
tendency *n. 10* тенденция; наклонность
tender *n. 6* тендер; коммерческое предложение; заявка на выполнение подряда
tensile *a. 1* напрягаемый; растянутый
tensile force *3* растягивающая сила; усилие растяжения
tensile strength *1* сопротивление разрыву; предел прочности на растяжение
tension *n. 7* растяжение; растягивающее усилие; напряжение; натяжение
tent *n. 10* палатка; шатер
termite *n. 1* термит
terrace *n. 2* терраса; насыпь; вал
terraced house *2* дом ленточной застройки
terrazzo *n. 11* терраццо
test *v. 10* подвергать испытанию
testing *n. 11* испытание; контроль; проверка
testing machine *11* машина для испытания механических свойств материалов; тестовый автомат
theatre *n. 5* театр
theodolite *n. 11* теодолит
therefore *adv. 10* поэтому; следовательно
thermal conductance *C* тепловая проводимость
thermal conductivity *5* (удельная) теплопроводимость
thermal insulation *5* теплоизоляция
thermal insulator *5* теплоизолятор
thermal resistance *C* тепловое сопротивление
thermometer *n. 11* термометр
thermostat *n. 5* термостат; стабилизатор температуры
thermostat control *5* терморегулятор
thick *a. 1* толстый; густой; плотный
thickness *n. 4* толщина; плотность; густота

water tower *9* водонапорная башня
water vapour *1* водяной пар
watt *n. 4* ватт
way *n. 12* 1) путь 2) метод, способ
weaken *v. 11* ослаблять; разбавлять
weakness *n. 8* слабость
wearing surface *3* 1) несущая поверхность 2) поверхность износа; слой износа
weather *n. 5* погода
weatherproof *a. 12* защищенный от атмосферных воздействий; устойчивый против выветривания
weathering *n. 12* выветривание
weather resistance *5* сопротивление атмосферным влияниям; атмосферостойкость
wedge-shaped *a. 3* клиновидный; клинообразный
weigh *v. 7* 1) весить 2) взвешивать
weight *n. 4* вес; груз; масса; нагрузка
weld *n. 3* сварной шов; сварное соединение
weld *v. 3* сваривать
welfare *n. 5* благосостояние
west *n. 2* запад
wet *a. 7* мокрый; сырой
wet and dry rot *8* 1) гниение древесины, вызываемое переменным действием влажности и сухости 2) гниль
whole *a. 11* единый; весь; неразъемный; целый
whole *n. 6* единое целое
wide *a. 4* широкий; обширный
widely *adv. 12* широко
widen *v. 10* расширять
width *n. 4* ширина
wigwam *n. 7* вигвам
wind *n. 5* ветер
wind penetration *7* продувание ветром
window area *7* площадь окна
window head *B* оконная перемычка
window pane *1* оконное стекло
wire strippers *11* инструмент для зачистки концов изолированного провода
withstand *v.* **(withstood, withstood)** *5* противостоять; сопротивляться, выдерживать
wood *n. 1* древесина; лесоматериал
wood-wool slab *C* фибролитовая плита; древесноопилочная плита
woodwork *n. 12* 1) столярные работы; 2) изделия из древесины; 3) деревянные части здания
wool *n. 1* 1) шерсть 2) вата
work *n. 6* работа
workability *n. 11* удобообрабатываемость; удобоукладываемость
working drawing *11* рабочий чертеж
working plane *11* рабочая поверхность
workman *n.* (*pl.* **workmen)** *11* рабочий
woven mat *12* плетеная циновка

Y

yard *n.* **(= 3 feet)** *12* ярд *(914,4 мм)*

Z

zigzag *a. 1* ломаный; зигзагообразный
zinc *n. 1* цинк
zone *n. 12* зона, пояс; полоса, район
Z-shaped *a. 1* Z-образный
Zulu hut *7* зулусская хижина

underneath *pr., adv. B* под; внизу, ниже
underside *n. 4* обратная сторона; днище; подошва
uneven *a. 3* шероховатый; неровный
unexposed *a. 12* неэкспонированный, не подверженный какому-л. воздействию
uniform *a. 11* однообразный; однородный
uninsulated *a. 9* неизолированный
unit *n. 1* 1) элемент 2) узел; блок 3) агрегат 4) единица
university *n. 4* университет
unlikely *a. 10* невероятный; маловероятный
unobstructed *a. 11* беспрепятственный; свободный
unpredictable *a. 10* непредсказуемый
unstable *a. C* неустойчивый; нестабильный
upper *a. 6* верхний; высший
upper floor *6* верхний этаж
upwards *adv. 10* вверх
use *n. 7* 1) использование 2) употребление 3) назначение
use *v. 1* использовать; применять; употреблять
usually *adv. 10* обычно
U-value *n. C* 1) коэффициент теплопередачи 2) коэффициент теплоусвоения

V

value *n. 10* 1) значение 2) величина
vapour barrier *C* пароизоляция; паронепроницаемый слой
variable *n. 7* 1) переменная величина 2) параметр
variable *a. 10* изменчивый; непостоянный; переменный
various *a. 11* различный, разнообразный
vary *v. 4* менять(ся); изменять(ся)
vault *n. 3* свод
vehicle *n. 10* 1) транспортное средство 2) машина
vegetable material *1* материал растительного происхождения
vehicular access *2* подъезд для транспорта
ventilate *v. 8* вентилировать; проветривать
ventilation *n. 5* вентиляция; воздухообмен; проветривание
vent pipe *8* вентиляционный канал; вытяжная (выпускная) труба
verandah *n. 12* веранда
vertical *a. 3* вертикальный; отвесный
verticality *n. 11* вертикальное положение; вертикальность; отвесность
vice *n. 11* тиски
view *n. 2* вид; перспектива; обзор
vine *n. 12* виноградная лоза
vinyl *n. 3* винил
visible *a. 11* видимый
visit *v. 6* посещать
visual *a. 5* видимый; визуальный; зрительный
voltage *n. 11* электрическое напряжение
voltmeter *n. 11* вольтметр
volume *n. 4* объем; вместимость; емкость

W

walkway *n. A* пешеходная дорожка; проход
wall cladding *3* наружная обшивка стен
wall column *A* колонна (полуколонна), полностью или частично заделанная в стену
warehouse *n. 5* пакгауз; товарный склад; хранилище
warm *a. 2* теплый; подогретый
warping *n. 12* коробление; искривление
wash away *v. 8* вымывать
waste pipe *2* 1) канализационная спускная труба 2) сбросная труба
water *n. 1* вода
water beater *2* водонагреватель
waterproof *a. 3* водонепроницаемый; водостойкий; водоупорный; герметичный

R	average reflectance of ceiling, floor and all walls *11* средний коэффициент отражения потолка, пола и всех стен
r.c.	reinforced concrete *8* железобетон
RH	relative humidity *7* относительная влажность
r.s./w.	roof support/wall *8* опора крыши/стена
S	area of window *11* площадь окна
s	second *4* секунда
S	South *2* юг
sctn	section *11* профиль
Sept.	September *7* сентябрь
SI	(International) System of Units *4* (международная) система единиц СИ
sq m	square metre *B* квадратный метр
str flr	structural failure *8* конструктивная ошибка
strn on str	strain on structure *8* деформация конструкции
SV	safety valve *8* предохранительный клапан
T	temperature *9* температура
t.s.	tensile strength *8* сопротивление разрыву
U	overall thermal conductance *C* полная теплопроводимость
USA	United States of America *3* Соединенные Штаты Америки, США
w	watt *C* ватт
W	West *2* запад
W	surface area *9* площадь поверхности прямоугольной призмы
w.c.	water closet *8* уборная
w.p.	working plane *11* рабочая поверхность
x	thickness *C* плотность; толщина

СПИСОК СОКРАЩЕНИЙ, ИСПОЛЬЗУЕМЫХ В КНИГЕ

A	ampere *4* ампер
A	total area of ceiling, floor and walls *11* общая площадь потолка, пола и стен
A	answer *7* ответ
AD	Anno Domini *лат.* (in the name of God) *7* нашей эры
Apr.	April *7* апрель
Aug.	August *7* август
B	bath *8* ванная
c	ceiling *11* потолок
C	Celsius (Temperature Scale) *4* температурная шкала, градуированная в градусах Цельсия
C	cold water *8* холодная вода
clps of bm	collapse of beam *8* разрушение балки
c.r.	chemical reaction *8* химическая реакция
dB	decibel *4* децибел
D	diameter *9* диаметр
Dec.	December *7* декабрь
E	East *2* восток
e.g.	exempli gratia *лат.* (for example) *1* например
erthquks	earthquakes *8* землетрясения
etc.	et cetera *лат.* (and so forth) *4* и так далее
f	floor *11* пол
Feb.	February *7* февраль
flts in dsgn	faults in design *8* погрешности в разработке
fndtns	foundations *8* основания
H	hot water *8* горячая вода
h.a.c.	high alumina cement *8* глиноземистый цемент
h.w.	hot water *8* горячая вода
i.e.	id est *лат.* (that is) *1* то есть
J	joule *4* джоуль
Jan.	January *7* январь
k	thermal conductivity *C* удельная теплопроводимость
k	kilogramme *6* килограмм
kg	kilogramme *4* килограмм
L	length *9* длина
lm	lumen *4* люмен
lx	lux *4* люкс
m	metre *2* метр
Mar.	March *7* март
mm	millimetre *4* миллиметр
N	newton *4* ньютон
N	North *2* север
n.c.	natural causes *8* естественные причины
Nov.	November *7* ноябрь
Oct.	October *7* октябрь
PF	primary flow *8* прямой стояк
PR	primary return *8* обратный стояк/«обратка»
Q	question *7* вопрос
r	resistance *C* тепловое сопротивление
R	overall thermal resistance *C* полное тепловое сопротивление

$+$	plus (sign of addition), positive
$-$	minus (sign of subtraction), negative
$\pm$	plus or minus (minus or plus)
x	times by (multiplication sign)
$\cdot$	multiplied by
$:$	sign of division; colon, ratios sign; divided by
$=$	sign of equality
( )	1) round brackets 2) parentheses
[ ]	1) square brackets 2) brackets
{ }	braces
Σ	sigma [śɪgmə], summation of
$a=b$	1) *a* equals *b* 2) *a* is equal to *b* 3) *a* is *b*
$a \neq b$	*a* is not equal to *b*; *a* is not *b*
$a \pm b$	*a* plus or minus *b*
$a \approx b$	*a* approximately equals *b*
$a>b$	*a* is greater than *b*
$a<b$	*a* is less than *b*
$x=\infty$	*x* approaches infinity
$a \geq b$	*a* is equal to or greater than *b*
$1 \times 1=1$	once one is one
$2 \times 2=4$	twice two is four
$6 \times 5=30$	six times five or 6 multiplied by 5 is (equals; is equal to; are, makes; make) thirty
$30=6 \times 5$	thirty is five times as large as six
$s=vt$	1) *s* equals (is equal to) *v* multiplied by *t* 2) *s* equals *v* times *t*
1:2	the ratio of one to two
12:3=4	1) 12 divided by 3 equals 4 2) 12 divided by 3 is 4
20:5=16:4	1) the ratio of 20 to 5 equals the ratio of 16 to 4 2) 20 is to 5 as 16 is to 4
$v=s/t$	1) *v* equals *s* divided by *t* 2) *v* is *s* over *t*
$a+b=c$	*a* plus *b* is (are; equals; is equal to) *c*
$7+3<12$	7 plus 3 is less than 12
$12>7+3$	12 is greater than 7 plus 3
$c-b=a$	1) *c* minus *b* is (equals; is equal to; leaves) *a* 2) *b* from *c* leaves *a*
$72-16=56$	1) 72 minus 16 is (equals; is equal to) 56 2) 16 from 72 equals (leaves) 56

ПРАВИЛА ЧТЕНИЯ МАТЕМАТИЧЕСКИХ И ИНЫХ СИМВОЛОВ

Дробные числительные (Fractional Numerals)

Простые дроби (Common Fractions)

Числитель выражается количественным числительным (three, ten, thirty-six и т.д.), а знаменатель — порядковым (third, tenth, thirty-sixth и т. д.). Если числитель больше единицы, то знаменатель принимает окончание множественного числа *-s*.

1/2	a half; one half
1/3	a third; one third
1/4	a) a quarter; one quarter b) a fourth; one fourth
1/10	a tenth; one tenth
1/100	a (one) hundredth
1/1000	a (one) thousandth
1/1234	a (one) thousand two hundred and thirty-fourth
3/4	a) three fourths b) three quarters
2 1/2	two and a half
4 1/3	four and a third
125 3/4	a (one) hundred and twenty-five and three-fourths (three quarters)

Десятичные дроби (Decimal Fractions)

В десятичных дробях целое число отделяется от дроби точкой, называемой **point**. Каждая цифра читается отдельно. «Ноль целых» может совсем не ставиться и не читаться или читаться одним из следующих трех способов: **o** [əʊ], **nought** [nɔ:t], **zero** [ˈzɪərəʊ].

0.1 .1	1) o point one 2) nought point one 3) zero point one 4) point one
0.01 .01	1) o point o one 2) nought point nought one 3) zero point zero one 4) point nought one 5) point zero one
0.25 .25	1) nought point two five 2) point two five
2.35	two point three five
45.67	1) four five point six seven 2) forty-five point six seven
0.001 .001	1) o point o o one 2) nought point nought nought one 3) zero point zero zero one 4) point nought nought one 5) point two oes one

ПРОЦЕНТЫ

%	per cent; pct; p.c.
2 %	two per cent; 2 p.c.
$^{3}/_{8}$%	1) three eighths per cent 2) three eighths of one per cent
0.5 %	1) a half per cent 2) a half of one per cent
0.3 %	1) point three per cent 2) nought point three per cent 3) zero point three of one per cent

Примечание: **Cent** во множественном числе не принимает окончания *-s*.

Именованные числа

2/3 ton	two thirds of a ton
1/2 ton	half a ton (перед half нет артикля, перед ton отсутствует of)
3/4 km	three quarters of a kilometer
.75	point seven five of a kilometer
1.75	one point seven five kilometers
13 lbs, 13 lb	thirteen pounds
1 1/2 hrs, 1 1/2 hr	1) one and a half hours 2) one (an) hour and a half
2 1/3 lbs, 2 1/3 lb	1) two and a third pound 2) two pounds and a third
60 mi/hr	sixty miles per hour
240 km/4 hr	240 kilometers per 4 hours
6 ft/sec	6 feet per second
1 ft/sec	1 foot per second
74 cu. yd./hr	74 cubic yards per hour
31 m.p.h.	31 miles per hour
40 h.p., 40 HP	40 horse power
kg/cm^2	kilogram per square centimeter
k/sq. in.	kip per square inch (1000 pounds per square inch)
20°	twenty degrees
6'	1) 6 minutes 2) 6 feet
10"	1) 10 seconds 2) 10 inches
0°C	zero degrees Centigrade (Celsius)
100° C	one (a) hundred degrees Centigrade
32° F	thirty-two degrees Fahrenheit
200 r.p.m.	two hundred revolutions per minute

x^2	1) *x* square; *x* squared 2) *x* to the second power 3) the square of *x* 4) the second power of *x*
$5^2 = 25$	1) the second power of 5 is 25 2) 5 square is 25 3) 5 to the second power is equal to 25 4) the square of 5 is 25
y^3	1) *y* cubed; *y* cube 2) *y* to the third power 3) the cube of *y* 4) *y* to the third power
z^{-10}	1) *z* to the minus tenth 2) *z* to the minus tenth power
$\sqrt{4} = \pm 2$	the square root of 4 is (equals) plus or minus 2
$\sqrt{a}$	the square root of *a*
$\sqrt[3]{a}$	the cube root of *a*
$\sqrt[5]{a^2}$	the fifth root of *a* square
a'	*a* prime
a''	1) *a* second prime 2) *a* double prime
a_1	*a* first
a_2	*a* second
am	*a* *m*-th; *a* sub *m*
R_a	*R* *a*-th; *R* sub *a*
f_c	*f* *c*-th prime; *f* sub *c* prime
a'_1	*a* first prime
a''_2	*a* second prime
$y = f(x)$	*y* is a function of *x*
$a = V_1 - V/T$	*a* equals (is equal to), line of division (dash) *v* sub *t* minus *v* divided by (over) *t*

~ tilde/squiggle/swung dash
, tail/comma
+ plus/intersection
% per cent/double-oh-seven
' acute accent/eh
‘ grave accent
« » guillemets (French brackets)

Шкала температурных соответствий

по Цельсию	по Фаренгейту
–17,8°	0°
–10°	14°
0°	32°
10°	50°
20°	68°
30°	86°

РАЗЛИЧНЫЕ СИМВОЛЫ И ИХ ЗНАЧЕНИЯ

<table>
<tr><td>!</td><td>exclamation mark/excl/wow/exclam/bang/shriek</td></tr>
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<tr><td>=</td><td>equals/half-mesh</td></tr>
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<tr><td>$</td><td>dollar</td></tr>
<tr><td>©</td><td>copyright</td></tr>
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<tr><td>·</td><td>decimal point/centred dot ... ellipsis/dot dot dot</td></tr>
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<tr><td>@</td><td>at/ at-sign/whirlpool</td></tr>
<tr><td>^</td><td>caret/ hat/shark fin/circumflex</td></tr>
<tr><td>{}</td><td>brackets/curly brackets/braces/curly braces/embrace & bracelet</td></tr>
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<tr><td>[ ]</td><td>square brackets/U-turn/U-turn back</td></tr>
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<tr><td>'</td><td>prime/foot</td></tr>
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Учебное издание

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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ СТУДЕНТОВ АРХИТЕКТУРНЫХ И СТРОИТЕЛЬНЫХ СПЕЦИАЛЬНОСТЕЙ

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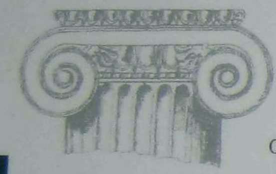

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